

**POSTER INSIDE: JAPAN'S SECRET WEAPON**

# AIR & SPACE

Smithsonian

NOVEMBER 2001

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CLEARED IN HOT



**STUPID PLANE TRICKS**

PAGE 58



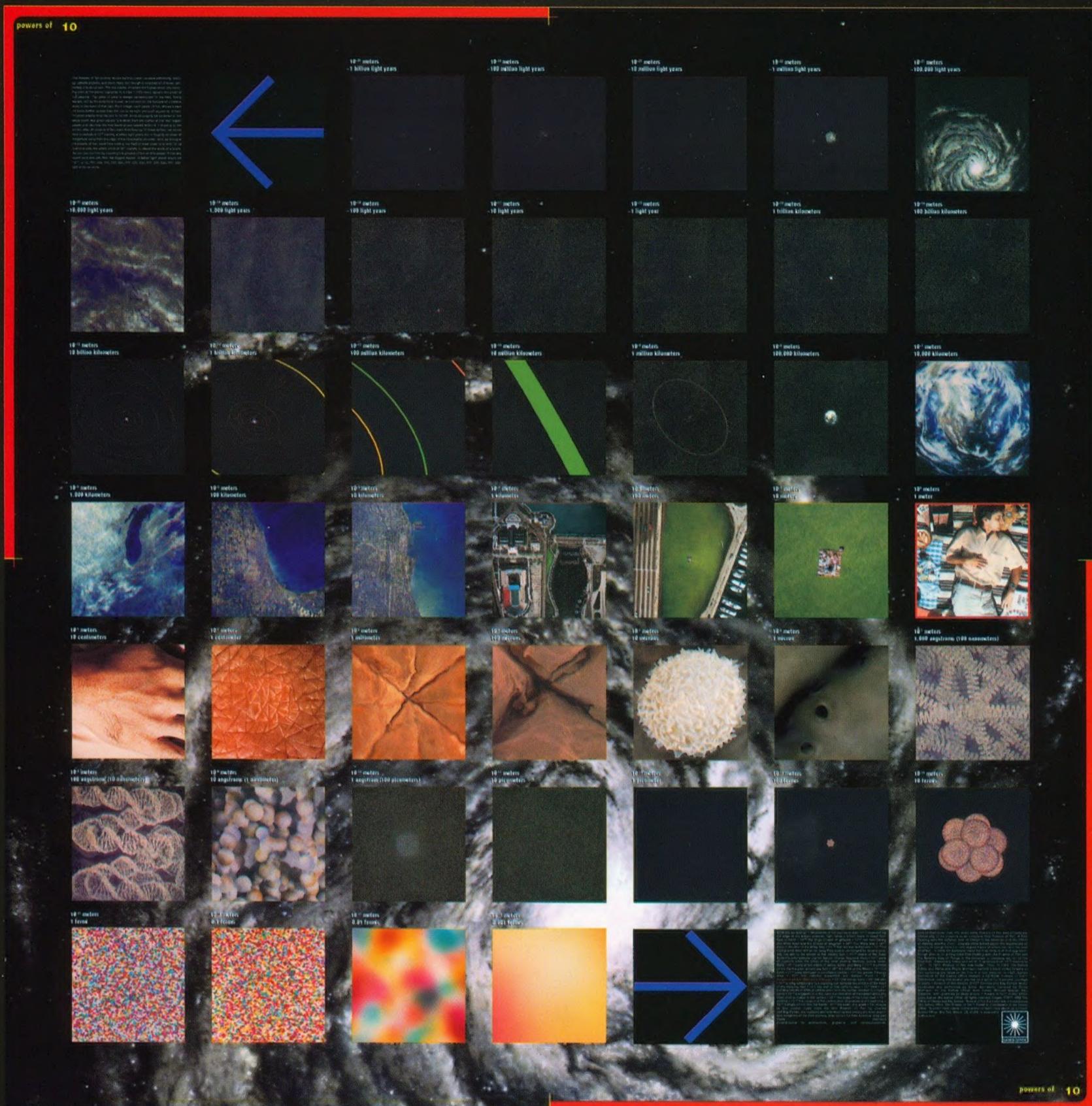
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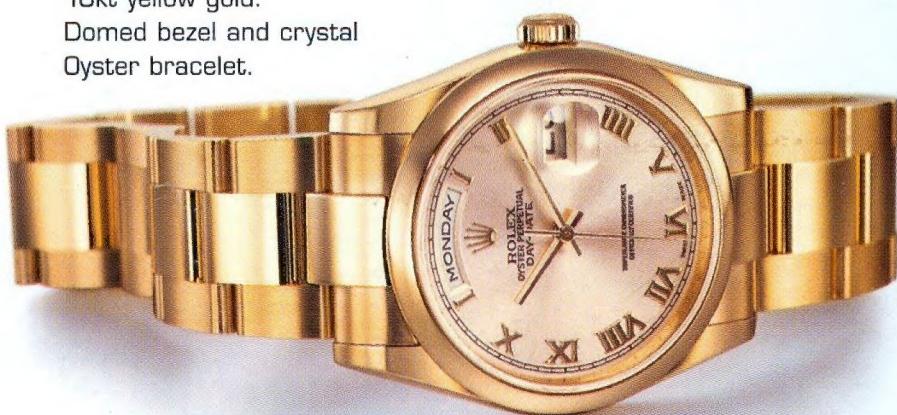
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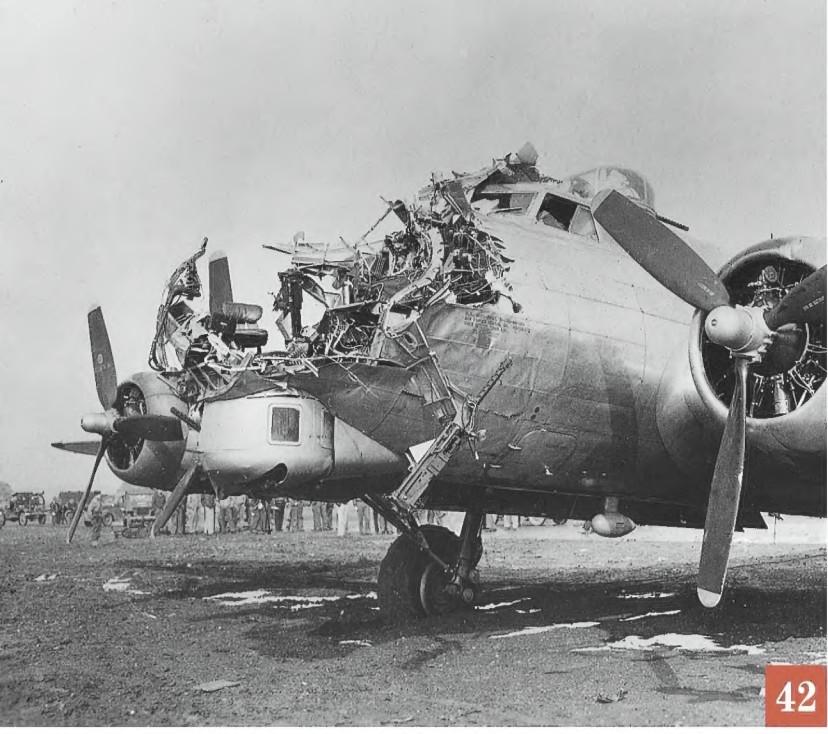


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# AIR & SPACE

Smithsonian

October/November 2001  
Volume 16 • Number 4

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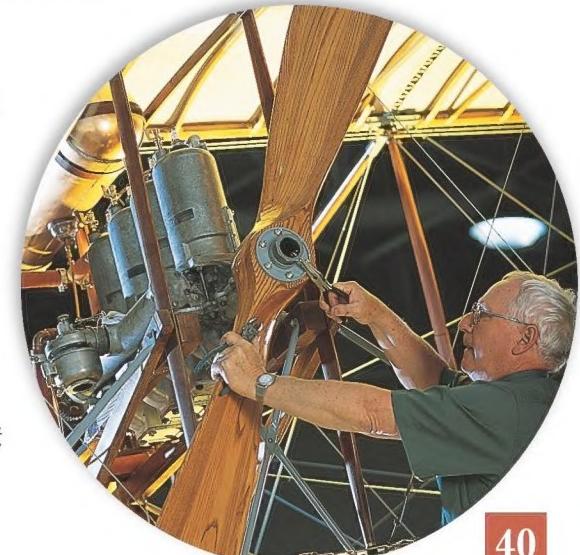
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Over a green New Brunswick forest last summer, a TBM Avenger-turned-tanker obliged photographer Chad Slattery by dousing the trees.



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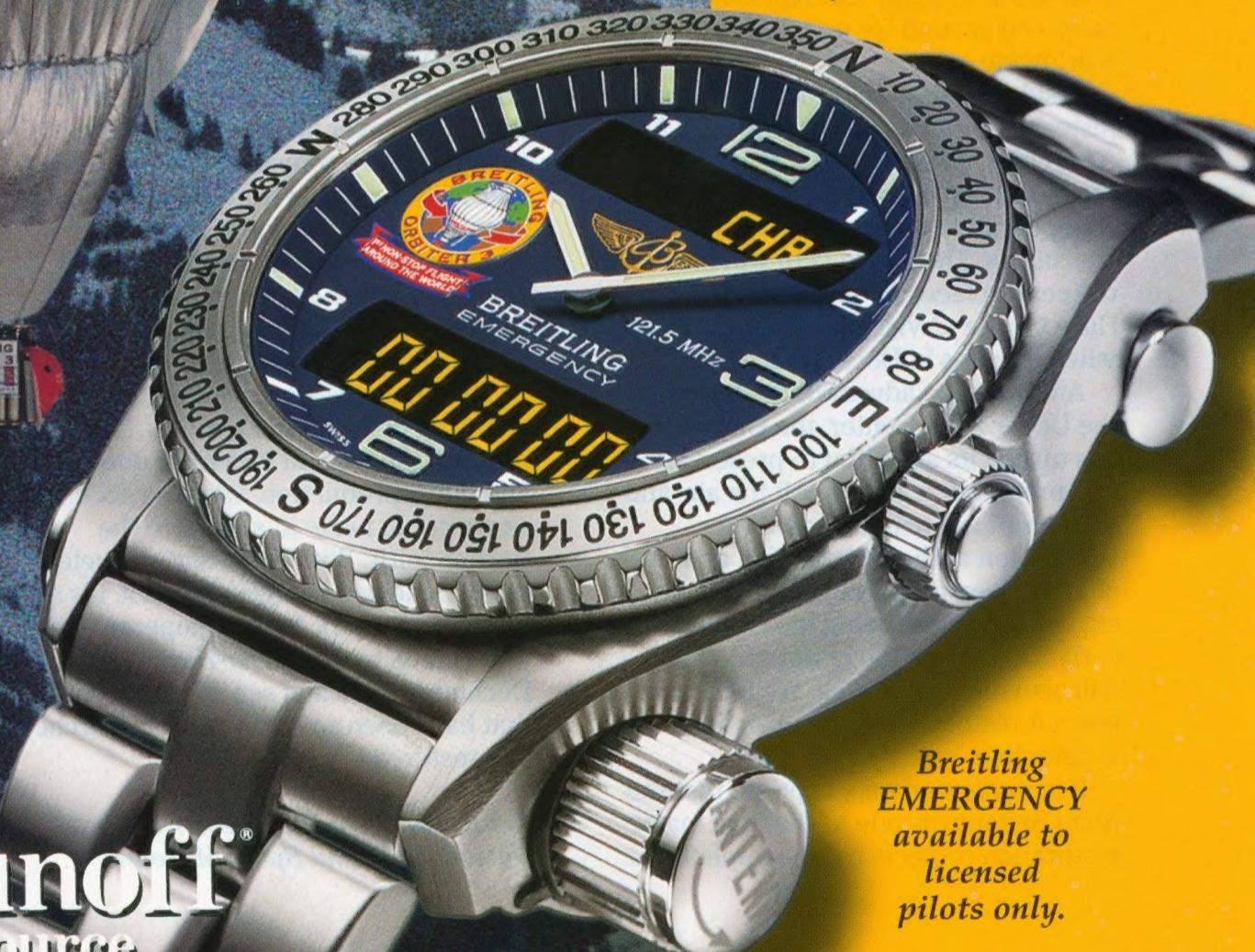
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# That's a Wrap!

**E**arly in May we celebrated the rollouts of three restorations at the National Air and Space Museum's Paul E. Garber facility. The Aichi M6A1 Seiran, the Hawker Hurricane, and the Pitts Special *Little Stinker* were the stars of the show, and they are the last projects we'll do for a while.

"Garber" is what used to be called "Silver Hill," the name of the Maryland neighborhood where it is located. In June 1980 the facility was renamed after Paul Garber, who joined the Smithsonian as its aviation curator in 1920 and acquired the heart of the aeronautical collection. Whether you call the place Garber or Silver Hill, it is recognized as a world-class center for aircraft restoration and hallowed ground for aviation enthusiasts worldwide.

Inside the shop in Building 10, such historic aircraft as the Boeing B-29 *Enola Gay*; Jack Northrop's first flying wing, the N-1M; a Messerschmitt Me 262; and a Nieuport 28 were restored by our specialists. The *Enola Gay* will be one of the centerpieces at the Steven F. Udvar-Hazy Center at Virginia's Dulles Airport when it opens in December 2003.

And with the advent of the move into the Udvar-Hazy Center, the Garber staff has turned its attention to preservation and preparation efforts. All the air- and spacecraft are being readied for installation at the new facility, and over 50 have been prepared already. We expect to begin moving the collection in early 2003, when the restoration shop will also move to Dulles. We'll resume aircraft restoration as soon as the move is complete.

It is particularly appropriate that the Aichi Seiran was one of the final major restoration projects to be completed at

Garber. The Seiran is a perfect example of the level of detail and the depth of research that go into one of our restorations. The results are beautiful to behold and as historically accurate as possible.

When we started the Seiran project, we found extensive corrosion that affected even the wing spar. We encountered the same situation when we began work on the floats. The skins had to be removed and the corroded structure repaired—a tremendously tedious process. Inside the wings were many interesting bits of history, several of which are described in "Team Seiran," a companion piece to "All and Nothing," a feature story about the Seiran in this issue (see p. 22).

The Seiran's history has only recently come to light, and most visitors tell us they have never heard of it. Enthusiasts in Japan also expressed intense interest, and several interns from Japan helped to ensure that the markings are accurate. The Tamiya model company donated funds to restore the floats, and we received \$1,000 from a group in Japan who had pooled their resources.

The final phase entailed building a beaching dolly for the aircraft. The only information we had was from photos, and our reproduction, while as accurate as we could make it, speaks to the Garber spirit. With its glossy enameled-steel frame and Douglas-fir deck, it's a beaching dolly fit for the emperor.

So come to the Udvar-Hazy Center in December 2003 and see all the aircraft that have been so thoroughly researched and restored.

—J.R. Dailey is the director of the National Air and Space Museum.

# AIR & SPACE

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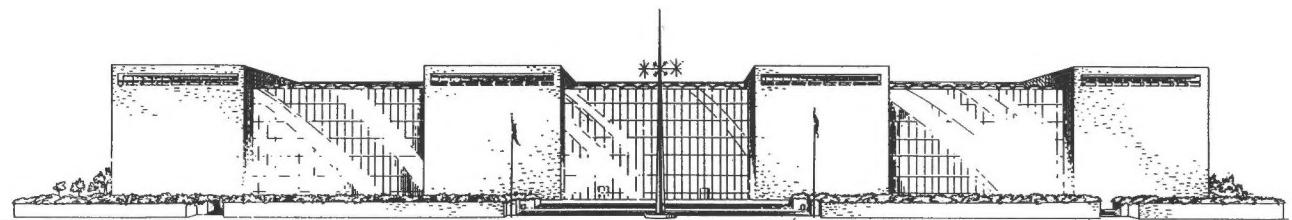
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**Subscription Prices:** U.S. and possessions: \$22 a year payable in U.S. funds. Canada and all other countries: add \$6.00 (U.S. funds) per year. Eighty-five percent of dues is designated for magazine subscription. Current issue price: \$3.95 (U.S. funds). Back issue price: \$7.00 (U.S. funds). Periodical postage paid at Washington, DC, and additional mailing offices.

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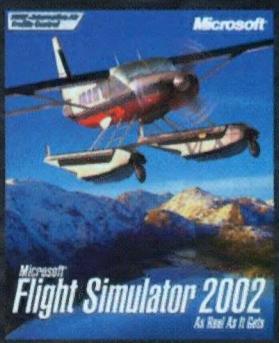


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## LETTERS

### Concorde Defense

I was a British Airways Concorde captain from 1977 until I retired in 1992, and I regard that airplane, out of the 70-plus types that I have flown, as being the safest and most rewarding ("The Concorde Redemption," Aug./Sept. 2001). I thought your article was detailed and objective; however, I would like to make the following points:

- No reference is made to the fact that the aircraft was about six tons overweight for a takeoff with an eight-knot tailwind, nor to the fact that the aircraft was probably about 1.5 tons over maximum structural takeoff weight.

- The aircraft took off with the center of gravity at or beyond the aft limits for takeoff. Combine that with a catastrophic leak from Tank #5 (forward of the center of gravity) and it does not require any great effort to imagine that the consequences would be a further rapid and rearward movement of the center of gravity. From the flight data recorder traces on the BEA (Bureau Enquête Accident) Web site, it would appear that the airplane crashed because it lost control as a result of the center of gravity moving too far aft.

- The flight engineer appears to have responded to a fire warning for the number 2 engine by shutting it down, uncommanded, at 25 feet radio altimeter height. This is not the accepted procedure for dealing with an engine fire on any airliner that I have knowledge of.

- The tire burst on this takeoff was unlike any other tire burst in the history of Concorde operations. The missing spacer was a major contributor to this catastrophe. Photographic evidence in the BEA's preliminary report eloquently supports the view that the missing spacer led to the left-hand undercarriage wheels becoming skewed and dragging the aircraft off the side of the runway and onto the grass at 180 knots or more. It also explains why the gear could not be retracted once the craft was airborne.

It was a combination of these factors that led to this accident, not a failure in the design of the aircraft. Concorde was grounded because it was supposed that a single failure (the tire burst) had caused the accident. In fact, it was a classic error chain that led to the disaster. Grounding the airplane was not justified.

Having said all that, I am sure that the measures being taken will make Concorde an even safer airplane than it ever was before.

—John Hutchinson  
Royston, England

### Planespotting

A few other places that are plane-watching heaven: in and around JFK International, New York ("Airports of Call," Aug./Sept. 2001). If the wind is north or west: Frank Charles Park in Howard Beach, Queens. If winds are south or east: Bayview Park in Inwood, Long Island. Bring lawn chairs and a picnic cooler, settle in from 9 a.m. to noon or 7 p.m. to 10 p.m., and be treated to an awesome display of international jumbo jets in all imaginable colors rumbling over your head on their way to the rest of the world. Also, Castle Island Park, South Boston, Massachusetts. This much-loved park sits right across Boston Inner Harbor from Logan International and has it all: sunrises, sunsets, city and water views, an old fort, playgrounds for kids, a fishing pier, good ham and cheese sandwiches at Sullivan's and planes coming and going all day long.

—Warren Hansen  
Forest Hills, New York

Baltimore-Washington International Airport has a superb observation area at the threshold of Runway 33L. Located on Dorsey Road, Maryland Route 176, the area has a parking area and a small playground, and is a terminus for an excellent bike and walking trail. The observer is able to watch landings of airliners, business jets, private aircraft, and occasional military aircraft. If the wind is out of the south, then takeoffs are the order of the day.

—Joseph G. Handelman  
Annapolis, Maryland

### Burtspotting

Could that be Burt Rutan assisting the leggy demo pilot into the BD-5 on page 36 ("That '70s Airshow," Aug./Sept. 2001)? He is a little thinner, but I would recognize those sideburns anywhere. The photo takes me back to my trips to Oshkosh in the '70s, when Mr. Rutan was the director of the Bede Test Center and later represented his own firm, Rutan Aircraft Factory, the precursor of Scaled Composites. I met him at the debut of his VariViggen, with Bede Aircraft, and later at the premiere of the VariEze. He always answered questions from this precocious boy pilot, and he ignited my lifelong interest in aircraft design.

—Norman E. Simpson  
Houston, Texas

*Editors' reply: You're right, that's Rutan.*

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**Inciting Rage**

"Air Rage Relief" (Commentary, Aug./Sept. 2001) addresses only the worst part of the problem. Like the tip of an iceberg, more of the problem lies below. Perhaps addressing this lower-level rage will reduce the use of plastic handcuffs.

Flying to Florida, we made a stop in Trenton. There I watched boarding passengers demonstrate air rage. First was the battle for overhead storage space. Duffle-bag-sized luggage was crammed in, then the covers slammed down. Previously stowed bags were moved, jammed, and, in one case, removed and handed to a seated passenger. Next, making clear that this was a problem begun at the desk, were demands for seat changes: "My travel agent told me I could change seats once we got here," "I must sit with my daughter," "We want to all sit together."

The pilot's contribution was first to announce that passengers needed to stow their bags and sit down. Then he asked that passengers "sit anywhere" or we'd miss our takeoff position. We missed the takeoff position and departed a half-hour late. Only once have I seen carry-on baggage checked for size. The airlines' contribution to the carry-on problem is to post bins at the counter and suggest that if the baggage doesn't fit, it needs to be checked. Great, now why are these bins dusty and why do the airlines permit such huge bags to be brought on the airplane?

There is hope. On a Southwest Airlines flight to Tampa on Superbowl weekend, the gate attendants politely and firmly stopped passengers from carrying drinks onto the airplane. When the flight had to return for mechanical troubles, the cry of "Hey—free booze!" was ignored. In fact, the crew clearly was pushing soft drinks. All this was done with good humor and had the full support of the rest of the passengers.

—Grant C. Sulham  
Sumner, Washington

**Reunions Abound**

"The Reunion" (Aug./Sept. 2001) reminded me of an article I wrote for *The Winchester (Virginia) Star*, in 1995—briefly, a story about a B-24 top turret gunner on a mission to Ploesti, Germany, in World War II. Forced to bail out, he is circled by a P-51 to protect him from German fighters. The gunner is captured and brought to a POW camp. Within a day of his arrival, the Romanians

capitulated, and soon the U.S. Army Air Forces sent in a group of B-17s, modified for troop transport. The gunner, on one of the B-17s, noticed another welcome sight: a flight of P-51s was escorting the transports back to Italy. Unbeknownst to him, one of the P-51 pilots was the same pilot who had protected him in his parachute.

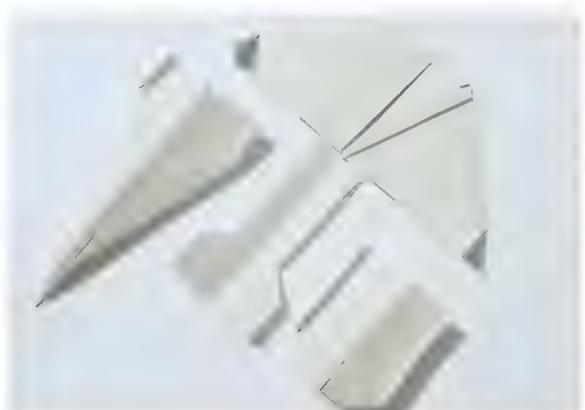
Now for the coincidence: the gunner lives in Hagerstown, Maryland, and the P-51 pilot lives in Front Royal, Virginia—and neither knew nor had met each other! I introduced them to each other, along with their wives, at the Winchester Regional Airport during the celebration of the 50th anniversary of the end of World War II. The story is also contained in my book, *Flying Tales of The Grey Baron*.

—Robert (The Grey Baron) Noyer  
Winchester, Virginia

**On Paper Wings**

Winglets were utilized in flight long before they appeared on '50s cars ("Winglets," How Things Work, Aug./Sept. 2001). I'm referring to the paper airplanes that were the rage among us kids during the '40s. Without their winglets, our tiny aircraft would have lacked the stability to stay aloft. Those cheap and pollution-free vehicles allowed our imaginations to soar with them. I often wonder what innovations in aviation were initiated by some youngster in his backyard "airport."

—Ed Archer  
Closter, NJ



Soesbe's winglet-equipped flier (middle) flanked by Archer's.

In the 1930s, when I was 10 or 12 years old, my friends and I made the enclosed paper airplane by the hundreds. Someone came up with the idea of bending the wingtips. We found that this extended the glide path quite a bit. If we bent them down, we got better aerobatics. Bending one down and the other up made the plane go nuts. It did

especially well when made from blue-lined school sheets.

—Bob Soesbe  
Clinton, Iowa

**Crumpled Goose**

The photo on the top right of page 52 ("Save the Blimp Base," Aug./Sept. 2001) is not a Widgeon; it's a Goose. The Grumman Widgeon of that era was powered by two 200-horsepower Ranger inverted six-cylinder in-line engines. The Goose had two 450-hp radial engines, as can be seen in the photo.

—Ron Kramer  
San Pedro, California

**Corrections**

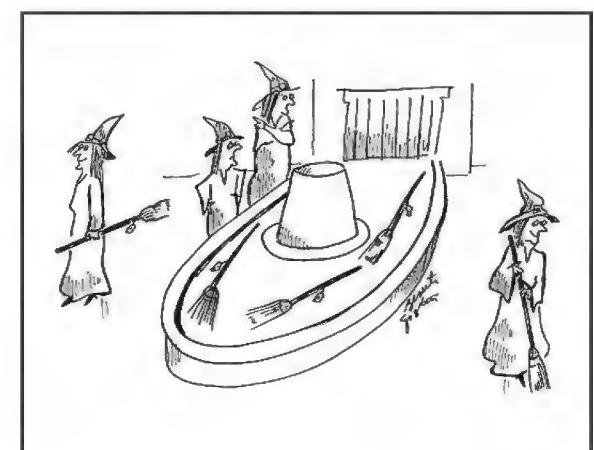
*Aug./Sept. 2001 "That '70s Airshow"*: A photo caption on page 36 identified the Army's helicopter demonstration team as the Silver Knights. They were named the Silver Eagles.

*"We Called It 'The Bug'"*: Page 69, first column, third paragraph: "If the astronaut wanted to hasten his rate of descent, he could change it in one-foot-per-minute increments..." should have read, "...in one-foot-per-second increments..."

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# “Gentlemen, Start Your Rockets”

**U**ntil just about five minutes ago, rockets were erratic, unreliable beasts that brave guys named Gus and Gordo strapped themselves onto and rode off into the final frontier. Soon, however, we'll all be heading out to watch pilots fly rockets in vertical drag races—that is, if Aleta Jackson has anything to say about it. Jackson works for a small Mojave, California, company called XCOR (“It doesn't mean anything—it's like Exxon,” Jackson says), which has vowed to build and produce a reliable, reusable rocket engine for orbital and sub-orbital space vehicles. “What we would like to do eventually is build vehicles that go to low Earth orbit and return on a routine basis,” Jackson explains. “We see a market for tourists flying low-Earth-orbit, ballistic, Alan Shepard rides, three minutes of weightlessness, then they come back down.”

But they're starting out with baby steps. Each rocket weighs just three pounds (*sans* oxygen and fuel tanks), each measures just five inches long and 2.5 inches in diameter (about the size of a Foster's Lager beer can), and each produces a whopping 400 pounds of thrust. They wanted to build an XCOR



Dick Rutan fires up a rocket-powered Long-EZ at California's Mojave Airport.

rocket-powered replica Bell X-1, but it made a poor glider, and because the aircraft must glide to a landing after exhausting its fuel, it wouldn't be the best airplane to put a rocket engine on. Then they thought of the Messerschmitt Me 163, but when they started pricing it they found such an airplane would cost around \$3 million for the first copy. So while those plans are on hold, they installed a pair of the rockets in the engine compartment of XCOR chief engineer Dan DeLong's Rutan Long-EZ. Last July pilot Dick Rutan—of globe-girdling *Voyager* fame—test-hopped the

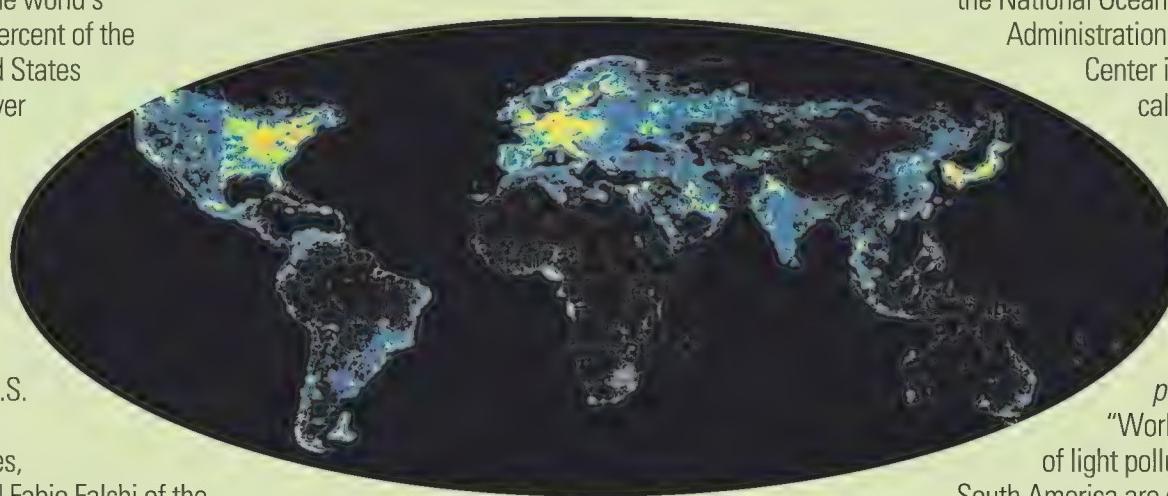
Long-EZ for 1,000 feet, rising to an altitude of some six feet before landing.

“With the EZ-Rocket, our testbed, two engines would drain the fuel tanks in two minutes,” says Jackson, “but in those two minutes the airplane will be at 10,000 feet and climbing.”

Which brings us back to those rocket-powered drag races. At last April's Space Access Society meeting in Scottsdale, Arizona, Ed Wright, who runs a company called X-Rocket, LLC, approached XCOR about showing the so-called EZ-Rocket at airshows next year. Wright hopes eventually to hold vertical drag races to

## Starry, Starry Night—Not

**S**ome two-thirds of the world's population and 99 percent of the population of the United States and western Europe never see a truly dark starry sky, according to a group of scientists who have compiled the *First World Atlas of Artificial Night Sky Brightness*. Using 1996–1997 data from U.S. Air Force Defense Meteorological Satellites, Pierantonio Cinzano and Fabio Falchi of the University of Padova in Italy and Chris Elvidge of



the National Oceanic and Atmospheric Administration's National Geophysical Data Center in Boulder, Colorado, calculated the extent to which artificial light is propagated through the atmosphere and produced a set of maps showing the severity of global light pollution. Visit the Web site [www.lightpollution.it/dmsp](http://www.lightpollution.it/dmsp) and select “World Atlas.” (The Y-shape bands of light pollution off the southeast tip of South America are created by fishing boats, which use large banks of lights to attract squid.)

an altitude of 100,000 feet. "We support it," says DeLong. "We would like to sell engines to anyone who would enter the drag races, and we will consider designing and building the vehicles. We might be able to sell them engines and make money—and we are in this to make money."

—Phil Scott

## Flight Test, 50 B.C. (Before Computers)

They're old men now, dressed in civvies rather than the flightsuits that used to be their second skin. But for one weekend last June, they turned back the clock to 1951, when they were the hottest pilots on the planet and the Mojave Desert officially became the center of the flight test universe.

"I call it the Golden Age—a pilot's dream," Chuck Yeager told the crowd gathered to commemorate the 50th anniversary of the Air Force Flight Test Center at Edwards Air Force Base. "There were so many airplanes and we were so short of test pilots that we flew 18 hours a day, seven days a week."

The festivities featured a living history of flight testing. Sneaking a cigarette outside the conference center was lifting-body aircraft pilot Jerry Gentry, who'd flown in from the East Coast—in a Cessna 210A—with X-15 ace Scott Crossfield. Meanwhile, inside, catching some shut-eye was Edward Cole, a retired pressure-suit technician who used to dress the indefatigable Fitz Fulton—he's flown 235 aircraft types. Fulton spent much of his time at the event trying to keep an uneasy peace between once-and-future rivals Yeager and Crossfield.

Retired technical director Fred Stoliker, a member of the center's Class of '51, was there with his daughter, Jan Tomeny, an Edwards-based flight test engineer on the Lockheed Martin F-22. Bill Dana, who arrived at Edwards in 1958 and eventually became chief pilot at NASA's Dryden Flight Research Center nearby, was also on hand, joined by Dick Horner, the center's first technical director. "It's just amazing to me," Horner said, referring to a half-century of progress. "We've fulfilled all of the objectives we had when we moved the center out here."

Muroc Field had been the site of ground-breaking test flights since 1942, but it wasn't until 1951 that the Air Force's Flight Test Center was transferred from Wright Field in Dayton, Ohio. What Edwards had to offer was unparalleled weather—345 sunny days a year—and 68 square miles of dry lakebeds to serve as runways. What it didn't have was, well, just about anything else. When the center's chief historian,

## COLLECTIONS



12 WING SHEARWATER (2)

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The Richard Byrd hangar in 1929 (top) and today, renovated by a Canadian navy diving unit (above, far right).

The groundwork laid by a U.S. Navy junior officer named Richard E. Byrd led to the founding of Canada's preeminent naval aviation museum. In August 1918, as World War I ground to a close, Byrd arrived on the outskirts of Halifax, Nova Scotia, charged with establishing a naval air station for Curtiss HS-2L flying boats that would search for German submarines. After the war, the government created Shearwater, a flying base for landplanes as well, that exists today. Its first unit was a seaplane squadron that assisted the Royal Canadian Mounted Police in pursuing rumrunners carrying their cargo from secluded Nova Scotia bays to thirsty New Englanders.

In 1978, the Shearwater Aviation Museum was established on the base as a repository of Canadian naval aviation history. The museum is a little gem, hidden away on the shores of Eastern Passage, where Byrd's seaplanes first flew. The collection includes 11 aircraft, thousands of artifacts and documents, and an art gallery; the most prized artifact is an airworthy Fairey Swordfish Mk.II, the famous old "Stringbag" torpedo biplane that crippled the Italian naval fleet in Taranto harbor in 1940 and helped sink the German battleship *Bismarck* the following year. Shearwater's other aircraft include a Fairey Firefly F.R. Mk.I, Grumman AS.3M (TBM-3) Avenger, McDonnell F2H-3 Banshee, and McDonnell Douglas CF-101 Voodoo.

—John B. Boileau

Jim Young, reminded Yeager that he'd once described the area as "the ass end of the universe," one onlooker muttered: "Still is."

To be fair, Edwards now boasts amenities ranging from a movie theater

and post office to a used-car lot and a golf course. But as the base became more civilized, the test pilot's job became more regimented. "We didn't have a bureaucracy," Crossfield recalled. "We didn't have a million computers telling us

what to do. When you're flying three or four airplanes a day, you need a lot of latitude."

This latitude exacted a terrible price—36 fatalities between 1951 and 1956, according to Air Force records. "You can look at every street [named for a test pilot] on the base and explain why [the pilot] killed himself: It was inexperience," Yeager says. "Today, we let a pilot fly only one or two [types of] airplanes. Back then, it was 15 or 20."

To modern sensibilities, these exploits seem far-fetched. But to the pilots flying the missions, they were merely par for the course. As Fulton put it, sounding almost sheepish: "Fifty years ago, I never thought I'd be up here on a panel telling what it was like 50 years back."

—Preston Lerner

## Rising to the Occasion

In the shadow of San Francisco International Airport in early June, while 747s, commuter and cargo airplanes, and bizjets performed their midday minuets, 42 helicopters vied for cheers at the Vertical Challenge 2001 Airshow at San Carlos Airport. Even NASA showed up with a unique craft.

Sponsored by the Hiller Aviation Museum of San Carlos, California, the second annual all-helicopter airshow drew 5,000 people. "That's probably about all we can handle," said Willie Turner, Hiller marketing director and air boss for the day.

Hiller Institute executive director and

retired Coast Guard Rear Admiral Bill Kozlovsky says Turner suggested demonstrating how helicopters contribute to daily life, from traffic reports to rescue to firefighting. The craft on hand ranged from the Coast Guard's Aerospatiale Dolphin to the airshow act "Otto," a red and white Hughes 269 with a clown face and ogling eyeballs. Also in attendance were Bell JetRangers, Aerospatiale Eurocopter AStars, and an Air Force Bell UH-1 Huey from Vandenberg Air Force Base. NASA flew its Autonomous Rotorcraft Yamaha RMAX, a remotely piloted 12-foot-long craft, a test vehicle for a "smart" unmanned aerial vehicle that can maneuver around obstacles on its own. A Marine Bell AH-1 Cobra from Camp Pendleton and an Army AH-64 Apache from the Utah National Guard were also on display.

When the rotors stopped turning, visitors turned to the education-focused Hiller Aviation Museum, which featured several unique craft, such as the museum's own XH-44 Hiller-copter, the first helicopter flown on the West Coast; the flight was made by then-20-year-old Stanley Hiller Jr. (on hand for the show), who built and flew his invention in 1944. Also on display was the forward section of Boeing's aborted supersonic transport and the Boeing Condor, a 1980s robotic composite reconnaissance testbed with a 201-foot wingspan.

Outside, Showcopters, an airshow team with three Robinson helicopters, dazzled the audience with a "cockeyed"

*Showcopters celebrated the versatility of helicopters at the Vertical Challenge airshow.*



## WORKS IN PROGRESS



MATTHEW SPARKS

### Gemini capsule lands in back yard

"My kids see it as their own private spacecraft," says Matthew Sparks, who rescued a "boilerplate" Gemini capsule from a scrapyard in northern California last November, and, with the help of friends, got the 2,000-pound capsule into his back yard.

Eighteen Gemini boilerplates, scale models, and test capsules were manufactured. By process of elimination, Sparks thinks his capsule is Gemini Boilerplate Spacecraft number 1, built by McDonnell Douglas in August 1962 and designated "MSC [Manned Spacecraft Center] 307," which is stamped on the hatches and the body. The steel mockup, which simulated the weight and center of gravity of the flight capsule, was used to test the parachute recovery system for project Gemini.

Sparks learned that his spacecraft had sat in an elementary school playground, painted in U.S. Bicentennial colors, with its lift hooks removed. One of its occupants, a schoolchild who grew up to run a scrapyard and machine shop, bought the capsule for scrap, and was happy to sell it to Sparks, who plans to restore it to its original configuration—maybe add an instrument panel and seats. "Where the paint is peeling, you can see the original Gemini Blue paint underneath," he says. "I've also discovered the original lettering 'UNITED STATES' is still partially intact under the paint on one side."

In 1967, Sparks entered the Revell Model Company contest to win a full-scale Gemini capsule (second prize: a Vox Sernander guitar, "the wild six-string with the big beat sound that's 'in' from L.A. to Liverpool."). "I was very disappointed when I didn't win," he says. "But now I have my own, so that's okay."

Readers with any information on the capsule can contact Sparks at [makaalasparks@hotmail.com](mailto:makaalasparks@hotmail.com) or write to Matthew Sparks, P.O. Box 1012, Meadow Vista, CA 95722-1012.

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## HEADS UP



## Airshow 2001 and Nose Art Exhibit

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The Confederate Air Force's grand opening celebration of the world's largest collection of nose art will be held at 11:30 a.m., Friday, October 5, at the American Airpower Heritage Museum. Stick around for Airshow 2001 October 6 and 7, featuring the CAF's World War II Airpower Demonstration and the trademark "Tora! Tora! Tora!" act.

This will be the last Confederate Air Force airshow. The organization will be renamed next January. CAF members will vote on a new name in October, choosing from Heritage Flying Museum, Ghost Squadron, Heritage Air Force, and Commemorative Air Force.

JAMES HYDER



JOE D. WILLIAMS

Dauntless sitting in the museum hangar. City officials balked, and after a year of negotiations dropped the idea and opted for a multi-media exhibit.

Last June, on the 59th anniversary of the battle, the exhibit opened at the new terminal without an airplane. While a band played "Anchors Aweigh," a handful of veterans wandered around the box-like structure, which was covered with a montage of black and white photographs of aircraft and carriers that starred in the Battle of Midway. Inside, brightly lit murals combined still images with computer-generated models, simulating scenes from the battle and producing a dizzying 3-D effect.

"It's nice, but it doesn't have the strength and vigor of a real live airplane," said Chuck Downey, who trained in a Dauntless and was decorated twice for valor in the Pacific. "It's just not a live enough exhibit."

Officials in Chicago's Department of Aviation insist they haven't closed the door on the project. Some point to a lack of funds, while others say there just wasn't enough space. Veterans involved in the project claim the city didn't listen to them and became enamored with the idea of a piece of modern art. The vets fear too much art and multi-media fictionalizes an event rapidly disappearing from memory. Since the dedication, Department of Aviation officials agreed to resume discussions with "an open mind."

Chicago's other big airport, O'Hare International, showcases an F4F Wildcat in honor of local pilot Butch O'Hare, who shot down five Japanese aircraft attacking the USS *Lexington* in World War II. One city councilman who had helped bring the Wildcat to O'Hare has jumped into the fray and helped form a committee to raise funds and overcome obstacles at Midway. Alderman Ed Burke brought a resolution before the city council in 1998 instructing the aviation department to find room for the Dauntless in the new terminal.

"High tech does a great job interpreting, but it is the presence of the real plane that inspires people," says Dave Truitt, who heads the Chicago Midway Memorial Committee. "This is about individual and collective heroism—real people who did real things."

—Hannah Hayes

exhibition: One helicopter flew left, one right, and one backward while a Super Stearman aimed straight up and hung motionless on its propeller.

Later, more than 100 people invested \$25 each for a ride in a Bell JetRanger, Otto, or Eurocopter AStar. "We could have flown more people if we'd used more helicopters," says Turner.

Scheduled to show off its forest-fire-fighting water-drop capabilities, the California Department of Forestry was called away to fight a real blaze. Next year, the Air National Guard unit from the Central Valley town of Stockton promises to bring its big Boeing CH-47 Chinook firefighting helicopter, and a spokesman says, "We'll drop a whole lake on you."

A woman in her 70s who summed up her day unpoetically but passionately—"This is a kick"—will probably be back for that.

—Bob McCafferty

## The Battle of Midway, Part II

Few air travelers realize Chicago's Midway Airport was named after the Battle of Midway, the turning point in the Pacific during World War II. So when the city announced plans to build a new terminal, officials agreed it should include an exhibit honoring those who fought in the battle. But just how to suitably memorialize the historic U.S. victory has put people in warring camps, and it appears the victor may be virtual reality.

A group of veterans and aviation enthusiasts want to display in the new facility a rare Douglas SBD Dauntless, the dive bomber credited with destroying the Japanese fleet during the crucial 1942 battle. The National Museum of Naval Aviation in Pensacola, Florida, agreed to loan the city a Dauntless, provided the city help fund the restoration of a second

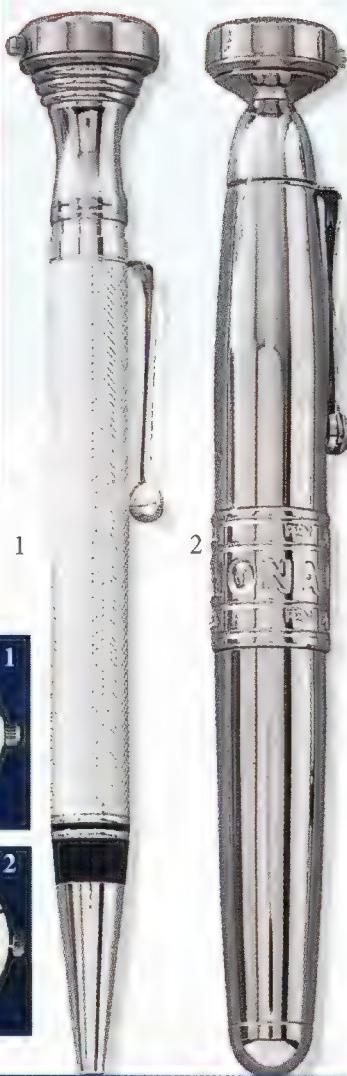
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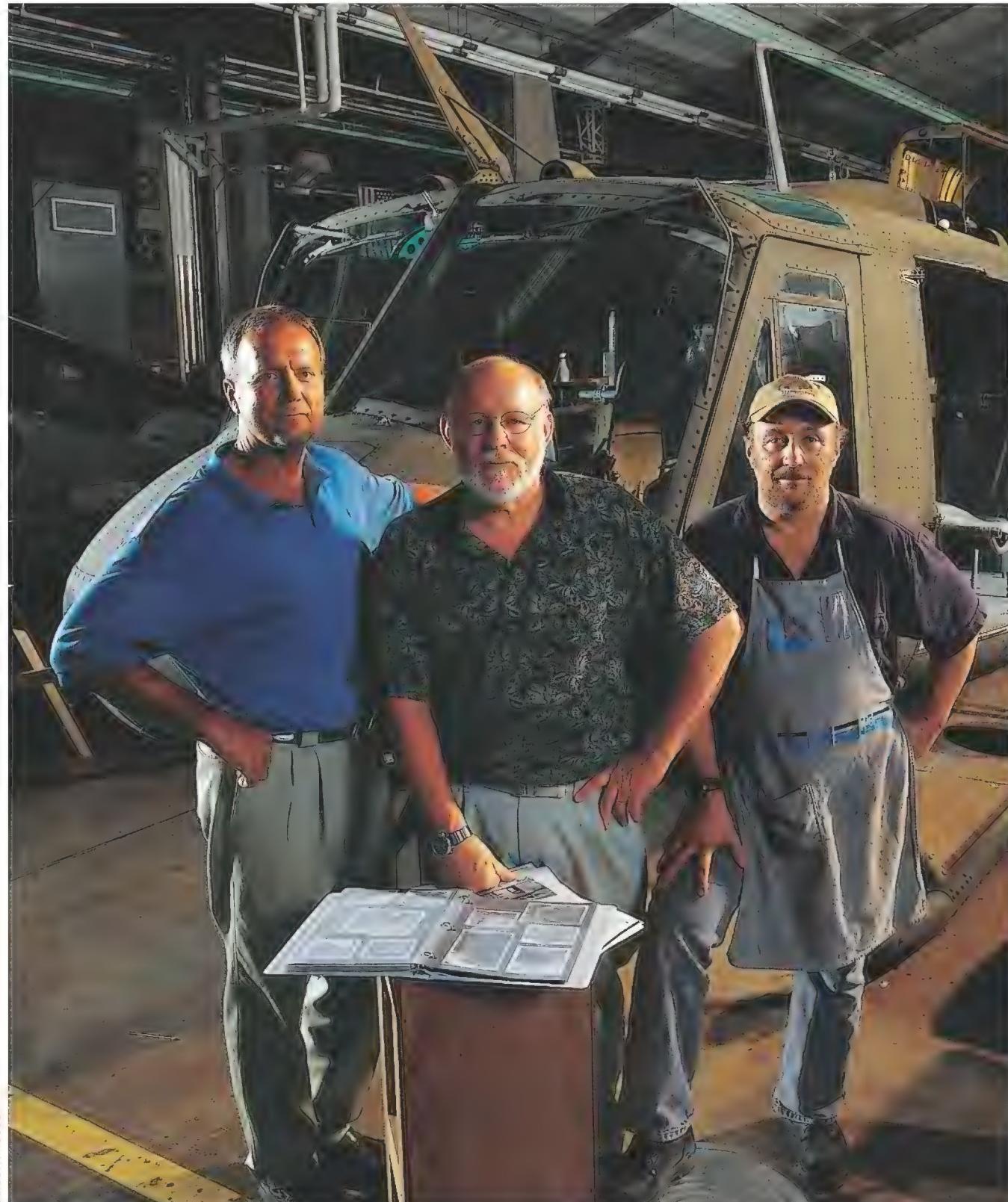
## Smokers Welcome

The three Vietnam vets gathered around the helicopter as it sat on the shop floor. They moved slowly around it, talking and pointing. Two of the men, Jim Palmer and Van Ponder, were intimately familiar with the craft's plain interior—corrugated aluminum floor, gray quilted-vinyl ceiling, and nylon seats. The two had been U.S. Army crew chiefs who flew aboard the Bell UH-1H Huey from 1967 to 1968 when they were stationed in Phu Loi. On this hot June day at the National Air and Space Museum's Garber restoration facility in Suitland, Maryland, they had come to share what they knew about the helicopter's history with fellow vet Michael Cross, the Garber restorer who would be responsible for refurbishing the craft.

"The Huey was the universal symbol for the Vietnam war," says Cross, who served in the U.S. Marine Corps. "Everyone knew it, and the enemy hated it. But it was a salvation to us. It came and got us." The enemy, in this case the Viet Cong and the North Vietnamese army, had reason to hate the Huey. During the war, some 5,000 of the helos buzzed about the country, transporting troops, evacuating the wounded, running reconnaissance missions, and—outfitted as gunships—shooting at the Viet Cong. During four tours of duty in Vietnam, the Museum's Huey accumulated more than 2,500 combat hours, many of them spent transporting soldiers.

The Museum helicopter, however, had a secret that makes it an extremely rare aircraft. After aeronautics curator Peter Jakab decided to acquire a troop-carrying Huey for the Museum's Vietnam war collection, he worked with the Vietnam Helicopter Pilots Association, whose members suggested several possibilities. Jakab settled on a helo at the U.S. Army Aviation Museum at Fort Rucker, Alabama. Several months after

CAROLYN RUSSO



*Van Ponder (left) and Jim Palmer (center) flew smoke missions aboard the Museum's Bell UH-1H, which was refurbished by technician Michael Cross (right).*

the helicopter was transported to Garber on a truck, Jakab, in an effort to learn more about the Huey's past, made contact with Palmer, who informed him that his acquisition had spent two years as a "smoker," one of only perhaps four such helicopters in the war. As a smoker, or smoke ship, it was the Huey's responsibility to lay down a cloud of smoke to conceal troops being deployed or extracted from landing zones under heavy fire.

Ponder and Palmer were assigned to the Army's 11th Combat Aviation Battalion, with Ponder serving until March 1968, at which point Palmer replaced him. In addition to doing the

maintenance that kept the smoker in flying condition, each man also flew aboard the helo on every smoke mission as a door gunner. "I think in the Army's wisdom they say, 'Well, make the guy who fixes [the helicopter] fly it every time, and that way there's a good chance it will work,'" says Palmer. Each Huey smoke ship had a crew of four: pilot, copilot, crew chief/door gunner, and door gunner. While either Palmer or Ponder would be sitting on one side of the aircraft, manning a pair of M-60 machine guns, his fellow door gunner would be sitting on the opposite side of the craft firing his own M-60s.

"We usually had one mission a day,"

## MUSEUM CALENDAR



A Huey practices a smoke run during stateside training in the late 1960s.

says Palmer. "It was early in the morning." The goal of the carefully timed mission was to drop off U.S. infantry troops into the jungles of South Vietnam for an assault. Before any helicopters landed, however, a U.S. Army artillery unit positioned several miles away fired a 155-mm-cannon barrage on enemy positions. Sometimes, after the artillery fire ceased, a flight of U.S. Air Force F-4 Phantoms would fly over the landing zone to launch rockets or drop bombs in an effort to "kind of clean out the area," says Palmer. Following closely behind the F-4s, a pair of helicopter gunships would fly through the landing zone, firing as they went.

Finally, it was time for the first flight of troop-carrying helicopters, known as "slicks," to land. Flying just in front of the slicks was the Huey smoke ship, equipped with a rubber bladder filled with oil. When the oil was pumped into the hot exhaust of the helo's turbine engine, it produced a plume of white smoke. Behind the cover of the smoke, the first flight of troop-carrying Hueys touched down for two or three seconds while the soldiers hit the ground running. As the next flight of slicks prepared to land, the smoke ship would turn around and fly back through the landing zone only inches from the ground to lay down a fresh plume of smoke, flying a figure-8 pattern until all of the troops had landed.

During these passes through the landing zone, both the crew chief and the door gunner would fire continuously in an effort to prevent the Viet Cong troops from popping up to fire their weapons. "It's amazing how you can be shooting

one [M-60] and unjamming the other one at the same time," says Ponder. "With all the shooting and the engine running and talking on radios, it's just a very adrenaline-flowing situation where you really don't pay any attention except just trying to stay alive."

Before Ponder and Palmer were reunited with the Huey, the Garber staff had begun making a few repairs. They had already drained the helicopter's fuel, oil, and hydraulic fluids, using pressurized air to flush out the fumes remaining in the helo's tanks. During the two-day defuming process, which took place outside the restoration shop, the helo attracted a lot of attention. "We're in the direct flight path for a lot of helicopters," Cross says of Garber's location, which lies between the Pentagon in Virginia and Andrews Air Force Base in Maryland. "And when they see one of their own on the ground, they tend to take a couple loops. It was like the hovering of the bees."

For now, the Huey is in storage, awaiting the move to the Museum's Steven F. Udvar-Hazy Center in northern Virginia, which is scheduled to open in December 2003. The helo is missing the gun and smoke systems that made it so special, but Cross hopes to restore it to its smoke ship configuration after the move. Palmer and Ponder plan to visit the Huey again when the Hazy center opens. Each man is content that his military flying days are over. "I really enjoyed it when I was there," says Ponder, "but I certainly wouldn't want to do it again."

—Diane Tedeschi

**October 4** Opening of "Aerobatic Champions," an exhibit featuring the airplanes of aerobatic pilots Leo Loudenlager and Betty Skelton. First floor, west end.

**October 9** G.E. Aviation Lecture: "An Evening with Chuck Yeager." In 1947 Brigadier General Charles E. "Chuck" Yeager broke the sound barrier in a history-making flight. Yeager will share memories of his days as a Bell X-1 test pilot. Langley IMAX Theater, 7:30 p.m.

**October 12** Earth Science Day. Go on a scavenger hunt, construct your own satellite, and talk with NASA earth scientists. 10 a.m. to 3 p.m.

**October 17** Opening of "Voyage, A Journey Through Our Solar System," a permanent outdoor installation. The exhibit, a model of the solar system 10 billion times smaller than the real thing, is made up of 13 display stations spanning 600 yards along Jefferson Drive between the Smithsonian Castle and the National Air and Space Museum.

**October 20 & November 17** Evening Stargazing. Join National Air and Space Museum staff astronomer Sean O'Brien for a night of observing celestial objects. Sky Meadows State Park, Virginia, (540) 592-3556, dusk to 11 p.m.

**Curator's Choice**  
Once a week a Museum curator will give a 15-minute talk about an artifact. Meet at the Museum Seal near the Information Desk at noon. Oct. 3, "Aerobatic Champions"; Oct. 10, "Lunar Module Ascent Engine"; Oct. 17, "Visible Universe"; Oct. 24, "Telescopic Universe"; Oct. 31, "Multi-Spectral Scanner."

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# Relief Flight

Last April 1, a Chinese F-8 fighter attempted to intercept a U.S. Navy EP-3 surveillance airplane over the South China Sea. The mission ended in a mid-air collision, resulting in the death of the F-8 pilot and the detainment of the EP-3 crew. As a former Naval Reserve P-3 pilot, I watched with interest as the United States and China exchanged verbal jabs in the first few days of the crisis. I was living on Guam—no longer flying for the Navy—as the chief pilot for Continental Micronesia, a subsidiary of Continental Airlines.

On Saturday, April 7, one week into the standoff, I got a call that would transform me from interested spectator to active participant in the effort to bring the Americans home. The call came from Ralph Freeman, Continental Micronesia's director of flight operations and my boss. He said the U.S. Department of State wanted to charter one of our 155-seat Boeing 737-800s to retrieve the 24 detained Americans. The Chinese were averse to a U.S. military transport landing on Hainan Island—they would accept only a civilian aircraft. Freeman was designating me captain. There was no definite departure date set for the mission, dubbed Operation Valiant Return by the military, but I was to consider myself on call until further notice.

We decided on two other pilots to complete the flight deck crew, captains Guy Greider and Pierre Frenay. We would also take two aircraft mechanics and a load planner. Finally, because we were also bringing a 14-member military repatriation team, we would take along five flight attendants. We were all released from normal duties while we awaited the green light to leave for Hainan.

A call to launch came the next day, followed quickly by a retraction. On Monday, another alarm came in and was withdrawn just as abruptly. The war of semantics between the two countries was dragging on, and the crafting of a solution satisfactory to both remained elusive.

On Wednesday, April 11, I had finished dinner with my family at a steakhouse

when I got a call from our operations center. The two sides were close to agreement. I went straight to the airport, where other crew members were assembling, and we immediately began preparations to depart. At 8 p.m., Mitch Dubner, Continental Airline's director of systems operations planning, called to advise that Air China had agreed to supply refueling services. Up to this point we weren't certain if we could get fuel when we got to Hainan. Our backup plan had been to depart Guam International with full tanks and stop in Manila on the way home to refuel.

We were growing increasingly anxious to leave, but still there was no definite word that tonight would be the night. Around 9:30, Dubner called again. The mission was a go, but the Chinese were insisting that we arrive no earlier than first light: 6 a.m. Further, as a matter of national pride, they did not want us to fly through Taiwanese airspace on the way. Accounting for these restrictions, we decided on a 2:15 a.m. departure.

As the hour drew near, our crew gathered for a final briefing with the repatriation team. We were told that there was a slight chance we would be intercepted by fighters as we approached Chinese airspace. But, explained the briefing officer, Chinese fighter pilots, with the exception of instructors, are not qualified to fly at night, so an intercept



*A Continental 737 crew flew the U.S. Navy EP-3 crew from detainment in China to Andersen Air Force Base in Guam.*

was not likely. I took this to be a joke at first, but was assured it was the case. In any event, we would have a U.S. Airborne Warning and Control System (AWACS) aircraft trailing us at long range. Using encrypting radios and satellite phones, we would at least be made aware of any intercept efforts ahead of time.

We departed over a black Pacific and headed west toward the Philippines. Due south of Hong Kong, we turned north as planned. Pierre was at the controls in the right seat when Hong Kong control unexpectedly cleared us via a shorter routing. We changed course, but before we even completed the turn, we received a concerned call on the phone in the cabin inquiring into the change in routing. The AWACS really was keeping a close watch on things. Since taking the shortcut would

result in an early arrival in China, we immediately reduced speed to arrive at the designated time.

Haikou airport came into view in the dim light of an overcast dawn. Pierre flew an Instrument Landing System approach to what proved to be a modern carrier airport, and after landing we were directed to a remote part of the ramp. We shut down the engines and were quickly surrounded by military personnel and vehicles. A ground handler plugged in a communications headset and informed us that only one person would be allowed off the aircraft at a time.

An Air China representative soon came aboard, gave us transit documentation to complete, and requested the passports of everyone on board. Our mechanic, Peter Lum, went below to monitor refueling. When that was complete, Guy left to perform a walkaround aircraft inspection.

We then waited while our repatriation team members met with their Chinese counterparts. After about an hour, one of the U.S. officers came back aboard, clearly agitated. To our embarrassment, the general declaration documents we had prepared back on Guam mistakenly listed our arrival point as Haikou, R.O.C. (Republic of China)—i.e., Taiwan. The Chinese were livid. He asked if I had the authority to amend this, which I did, quickly penning the change to “P.R.O.C.” for People’s Republic of China.

That apparently solved the problem, for shortly afterward two vans containing the detained Americans pulled up. One by one they bounded up the stairs, and each in turn was greeted by his unit’s commanding officers.

With all personnel aboard and accounted for, we waited five more minutes for the return of our passports. When they were brought aboard, we immediately started engines and called for taxi clearance. In a short while we were airborne, headed for Andersen Air Force Base on Guam. This time Guy was at the controls in the right seat. We had been on the ground less than two hours.

Soon we crossed the 12-mile limit marking the end of Chinese airspace, and received a text data-link message to contact our dispatch office by high-frequency radio. The U.S. ambassador to China, Joseph Prueher, was patched through by telephone, and he asked to speak with Shane Osborne, commander of the EP-3. After receiving congratulations from the ambassador and hanging up, Osborne remained in the cockpit for 25 minutes, relating what had transpired since the mid-air collision nearly two weeks before. We had the impression he was relieved to finally be able to tell the story to fellow Americans, pilot to pilot. The conversation soon

turned to the state-of-the-art glass cockpit of our airplane, and whether our airline was hiring pilots. I told him I’d send him an application, prompting his commanding officer, also in the cockpit, to remind him that he still owed the Navy a couple of years.

Meanwhile, back in the passenger cabin the mood was surprisingly subdued. I learned later that the returning crew members had quietly taken seats together at the back of the

In the cockpit, we had the impression that Osborne, commander of the EP-3, was relieved to finally be able to tell the story to fellow Americans, pilot to pilot.

relatively empty airplane. The air of celebration I had expected was missing. But about an hour and a half into the flight, that changed. While *Men of Honor* played on the video screens and the flight attendants dished up trout and chicken entrees, the group began to loosen up. It was all finally sinking in. They were going home. Because the military team needed continuous access to our HF radios, we kept the cockpit door open for the entire flight. Most of the EP-3 crew, by now mingling in the aisle, dropped in one or two at a time to thank us for the ride.

Several hours later we touched down at Andersen Air Force Base. Our passengers were back on U.S. soil and were mobbed by the press. After our own press interviews, it was my turn to fly the 10-minute trip to Guam International.

The media frenzy surrounding the whole story eventually subsided. Soon after we returned, the Navy thanked us by inviting our entire crew and our families for a tour of the carrier *Kitty Hawk*, which was making a liberty stop at Guam in celebration of its 40th birthday. Guy and Pierre even got a second visit a few days later, including a catapult shot off the ship, which by then was headed back to sea, in the carrier’s twin engine Grumman transport. But that was icing on the cake. The best thanks was having played a part in the happy conclusion to an unfortunate situation.

—Tom Pinardo, as told to  
Vincent Czaplyski

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## Closer to Mars

**I**t's a little past midnight on June 14, 2001, and Mars is a fiery orange dot in the Arizona sky. Tonight, if a line were drawn between Mars and the sun, it would pass through Earth. This geometry, called an opposition, occurs every 26 months. Telescopic observers eagerly await Mars oppositions, because they signal that the Red Planet is near Earth, making it bright in the sky and large in telescopes. Space explorers like oppositions because they are opportunities for Mars flights requiring relatively low energy. In this opposition, Mars is about 42 million miles away—the closest it has been in a dozen years.

As telescopes both in back yards and professional observatories focus on our shy little neighbor, I'm privileged to be squinting through the eyepiece of the 105-year-old telescope that truly made Mars come alive in the human imagination. It was here at Lowell Observatory in Flagstaff that Percival Lowell (1855–1916) began two decades of Mars observations, and where he set off worldwide speculation about the possibility of an advanced civilization inhabiting its surface.

I sit at the eyepiece waiting for random, surprising moments of clarity. Sometimes the dark surface areas on Mars' orange disk look greenish, suggesting vegetation. At other times they look brown and linked by pale broad lines that fade quickly. The lines hint at some pattern, like a hieroglyph carved by a lost civilization. Over a region called Elysium I think I see clouds, but it's tough to be sure.

Lowell was a Boston aristocrat drawn to things exotic. As a young man he lived in Japan and Korea. At mid-life, Lowell became passionate about Mars, and he journeyed into the mountains of the Arizona Territory in quest of clear skies. He established an observatory on a pine-covered ridge overlooking Flagstaff. The site, in tribute to Lowell's lifelong pursuit, became known as Mars Hill.

Lowell's telescope thrives today as part of the observatory's public outreach program, for which I work as a tour guide.

(Research is conducted with the facility's other telescopes.) The six-ton instrument is still aimed by hand, creaking as it pivots on its mount. A brass eyepiece holder caps the bottom of its 30-foot steel tube, and two stacked 24-inch-wide glass lenses cap the top. It's a refracting telescope, the last made by the respected Alvan G. Clark and widely rated the best of the Clark breed. In addition to its Mars observations, the telescope helped gather the earliest data showing the redshift of galaxies, which pointed to the expansion of the universe and the Big Bang. It was also used by the U.S. Air Force to map the moon for the Apollo program.

The current observatory director, Robert Millis, a co-discoverer of the rings of Uranus, told me that the Clark is an important artifact that represents a virtually extinct breed. "Ninety-five percent of all professional telescopes nowadays are reflectors," he says. Reflecting telescopes, with big curved mirrors instead of smaller, pricier lenses, began edging out refractors in the 1920s, as astronomers looked beyond the planets to dim, distant objects such as galaxies and nebulae.

Lowell's telescope traveled by train to Mexico to get a better look at the 1896 opposition—that year, Mars was low in the southern sky for northern observers, just as it was this year. There, Lowell glimpsed the mysterious lines on Mars first noted by Italian astronomer Giovanni Schiaparelli in 1877, and began careful cataloguing and mapping. Schiaparelli had called the lines *canali*, Italian for "grooves," but the English-language press mistranslated this as "canals."



LOWELL OBSERVATORY

Between 1895 and his death in 1916, Lowell published prolifically about Mars. He believed Mars was home to a culture whose aristocrats had marshaled vast scientific powers to carve the canal network he saw through his telescope. They did this, he wrote, to postpone their world's inevitable

desertification. Lowell was a popular speaker, dynamic and enthusiastic when he spoke on his favorite topic. Most astronomers, however, rightly derided his theories as unscientific.

Suddenly, a thin, sharp line on Mars springs into clarity in the eyepiece, interrupting my musings. As it splits and fades, I feel kinship with Lowell, interred now in a gray granite mausoleum just 50 feet from his beloved telescope. I've seen spacecraft images of Mars. I know that the thin lines are products of eyestrain, not Martians. Lowell, however, lacked our spacecraft data. He had only his eyes, his telescope, and his judgment. What would I have thought, had I seen those black, thread-like lines at the end of the 19th century, not the dawn of the 21st? Might I have become a believer in canals?

Lowell's observations, writings, and speeches inspired the first generation of rocketeers—Wernher von Braun, Sergei Korolev, and Robert Goddard—whose work led to the exploration of Mars by spacecraft. As I gaze through Lowell's old telescope, I imagine NASA's Mars Odyssey spacecraft en route to the Red Planet, taking advantage of the 2001 opposition. Our robot explorers have proven Lowell's theories wrong, but I think he would be delighted by the wonders they have found.

—David S.F. Portree

*"We should never forget..."*



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— GENERAL WILLIAM S. RADER, USAF (RET.) AND HIS WIFE MAJOR STEPHANIE C. RADER, USAF (RET.) in the Museum's World War II gallery. The mural behind them depicts a B-17 of the 303rd Bomb Group, which General Rader commanded during World War II.

PHOTO: ERIC LONG

As a B-17 pilot, he flew combat missions in both theaters in World War II - 72 of them over occupied Europe and Germany. She was a WAC Captain in London when their wartime romance began. They're honored to be part of the greatest generation - those who protected and defended the freedoms we all enjoy today. That's why General and Mrs. Rader are proud to have included a generous

bequest to the National Air and Space Museum in their estate plans. They are now members of the Smithsonian Legacy Society.

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ERIC LONG

*The navigator's station of the B-52 Stratofortress would have contained the attack plan for the Panama Canal.*

After Pearl Harbor, the Japanese planned to strike the United States with aircraft borne by giant submarines. If it worked, the Atlantic fleet would be trapped.

# A11 and N



A full-size mockup (above and below) showed how the seaplane folded and ensured it could fit into its hangar.

# nothing

BY THOMAS S. MOMIYAMA



KODOKAN [2]

Built in Skunk Works-style secrecy, the mission of the floatplane bomber was unknown to Allied intelligence.

Immediately after the December 7, 1941 attack on Pearl Harbor, Admiral of the Fleet Isoroku Yamamoto, supreme commander of the Imperial Japanese Navy's Combined Fleet and the originator of the Pearl Harbor attack strategy, met with his staff to plan the next move. The 1989 book *Phantom of Submarine Aircraft Carrier* cites an account by one of Yamamoto's staff officers that the admiral was working on another daring scheme. In the old Japanese organized crime groups, known as the *yakuza*, there is a gambling term—*kenkon itteki*, meaning "all or nothing, a one shot." Yamamoto was no *yakuza*, but he knew the meaning of the words.

Japan must "put our hands" on the U.S. mainland, he said, adding: "What other means is there than the aircraft-carrying submarine?" And so, just over a month later, on January 13, 1942, the Imperial Japanese Navy's *Kansei Honbu* (Ships Command Headquarters) received a request from the *Gunreibu* (Naval Operations Command) to study the possibility of designing a "40,000-nautical-mile range submarine with a capacity to carry attack aircraft each loaded with a torpedo or 800 kg [1,764 pound] bomb."

When Yamamoto had been assigned to prosecute Japan's war against the mighty naval powers of the United States and Great Britain, he considered the task impossible. Still, he had hoped to score a decisive win at Pearl Harbor to gain the upper hand in what would surely be a long and wearing war. Yamamoto knew he had to have another tactical victory if Japan were to win strategically or at least maneuver for an advantageous truce. Submarine-stowed aircraft for clandestine reconnaissance and attack against enemy ships had been built and tested by several seagoing nations as long ago as World War I. But Yamamoto's concept of using a submarine's stealth to deliver an airborne attack on strategic land targets was clearly a departure.

Japanese memoirs speculate that Yamamoto's vision for the *kenkon itteki* included targets like New York City or Washington, D.C. As planning progressed, however, the navy settled on a more pragmatic target: the Panama Canal, where a single raid, if successful, could prevent the U.S. Atlantic fleet from crossing to the Pacific. An undersea-borne air strike force would launch from the Gulf of Panama, cross Panama to the Caribbean Sea at low altitude, surprise the defenders by approaching from the Atlantic side, and bomb the critical Gatun Locks, which would put the canal out of operation for six months.

In early 1942, both the Ships Command Headquarters' submarine division and the Air Command Headquarters' *Kugisho* (Air Technical Bureau) began working on a submarine carrier and an attack aircraft that could be launched from it. Engineers developed two carrier submarine classes, called *sen-toku*, or special-type sub: One, an I-13-class sub, displaced 3,603 tons on the surface and had a range of 21,000 nautical miles. The larger, I-400, was 400 feet long, displaced 5,223 tons surfaced, and had a 37,500-nautical-mile range. Each was designed to carry two aircraft in a hangar tube built over the hull, but the I-400 was revised to carry three.

The aircraft designated M6A1 was one of the 17-shi (experimental aircraft initiated in the 17th year of Showa—1942) and was eventually named Seiran. ("Seiran" translates as *sei*, meaning "clear sky," and *ran*, meaning "storm," thus: "storm from the clear sky.") In a chapter he wrote in *Development and Records of Famous Aircraft* the Seiran's chief test pilot, Tadashi Funada, explained how he conceived of the name for the airplane: "An instruction came from the *Kaigun Kouku Honbu* (Naval Air Command Headquarters) to think up an appropriate name for the M6A1 Prototype Aircraft. I contemplated adding to the stealth of the submarine the 'limited visibility maneuvering ability (instrument flying skill)' of the floatplane pilots. As a metaphor for suddenly appearing out of the fog—like a Ninja—I thought of the name 'Seiran' from 'Seiran of Awazu.' " This is the title of a series of woodprints, by an 18th century master craftsman named Hiroshige, typically depicting mountain haze rising, presumably after a storm in Awazu, a picturesque town.

The design and construction were assigned by the *Kugisho* on May 15, 1942, to the Aichi *Kouku* (Aircraft) Company of Nagoya, which had already built several floatplanes for the navy. Basic design studies for the Seiran consumed Aichi for the rest of 1942, and the first prototype was completed in November 1943, followed by seven more. During 1944, flight tests at the *Kugisho* in Yokosuka were conducted and developmental changes made. In January 1945, the aircraft was ready for operational use.

Leadership of the project was entrusted to Aichi's chief designer, Toshio Ozaki, and the *Kugisho*'s chief test pilot, Lieutenant Commander Tadashi Funada. The effort to design a large, high-performance attack aircraft that would fold to fit into the hangar of a submarine was one thing. More critical were the design considerations to enable the crew to launch the aircraft within the limited time during which the submarine was surfaced. The expediency of the operation and the critically limited deck space for the crew called for a high level of automation and innovative human engineering.

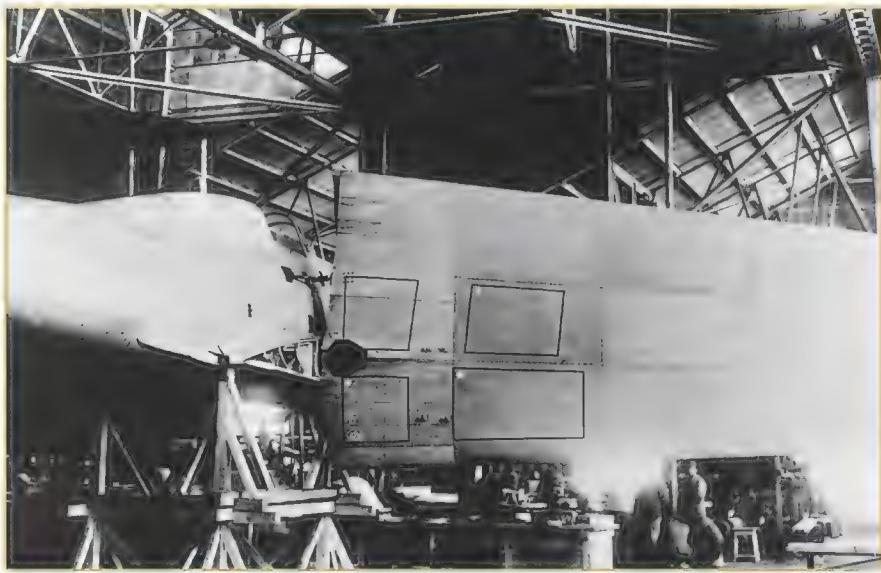
Ozaki has said the aircraft was originally conceived with no landing gear at all in order to attain maximum speed and range. After the mission the crew would fly back to the sub, ditch the aircraft, then be recovered aboard. Early in the aircraft design study, however, a pair of detachable floats was added as an option, based on a notion that the aircraft could attack several less significant targets before its final one-shot mission. Further, the floats would allow training flights from seaplane ramps and submarines. The submarines were equipped with cranes to recover the airplanes after landing. A provision for jettisoning the floats in flight, although considered during the design process, was never implemented.

Two of the eight prototypes were built with hand-cranked retractable wheeled landing gear. These land-based prototypes were used to establish the aircraft's characteristics without floats—and once to conduct crew



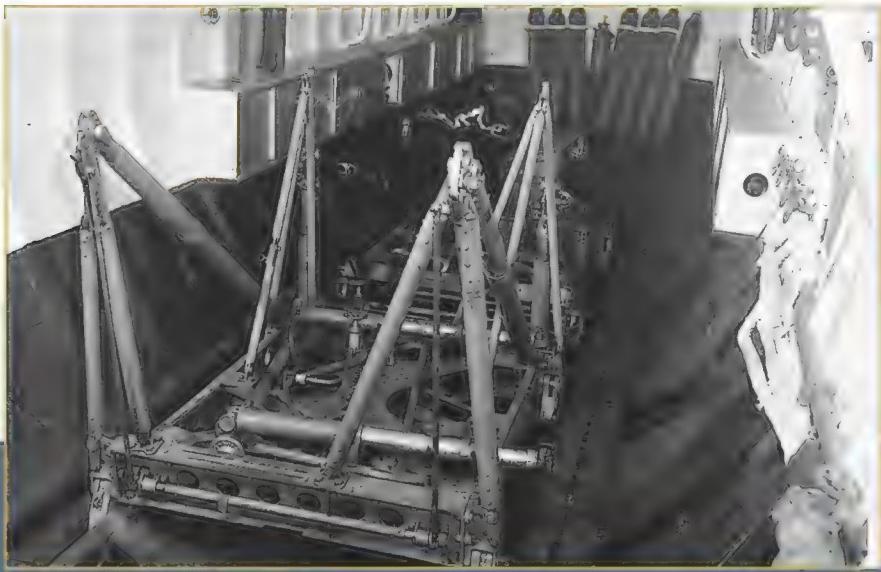
U.S. NAVY HISTORICAL CENTER

Giant I-400-class submarine carriers had bulging hangar tubes amidships that held three Seiran aircraft.



NATIONAL ARCHIVES

The Seiran's wings and their connecting spar rotated so they could fold back against the fuselage.



VASIM

This launch car rolled out of its hangar on tracks and held the Seiran at four attach points.

training against a simulated Panama Canal. These two M6A1-K, *Shi-Sei Seiran-Kai*, were given the name *Nan-zan* (southern mountain) to distinguish them from the seagoing versions. The innovations designed into the Aichi M6A1 made it one of the most advanced and complex Japanese aircraft of the war. The aircraft was probably the one that was least known to foreign military intelligence at that time, as well as to those with technical and historical interests, even today.

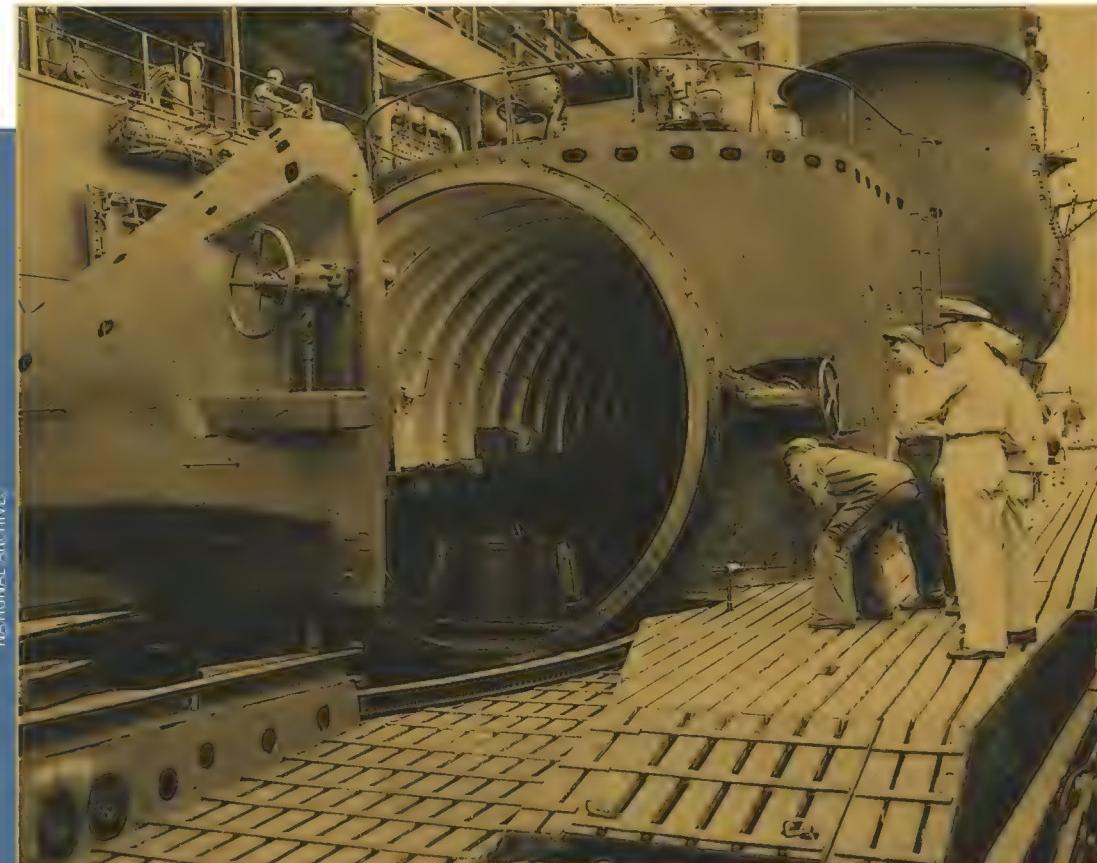
The project was top secret and well concealed. Allied intelligence knew so little about the Seiran that it was not even assigned a customary English code name. It was manufactured in a detached experimental-aircraft assembly building on a corner lot of Aichi's Eitoku plant on the river's edge, a place akin to Lockheed's celebrated Skunk Works. Training was carried out at dispersed secret bases.

A 1944 Allied Air Technical Intelligence Center report, now declassified, verifies that the Allies were aware of a "330-mph class" aircraft named M6A1 or Seiran (then translated as "clear day"). The half-page description noted that the aircraft was of "unusual design" and "for submarine use," and that the nomenclature gave no hint as to its type but indicated only that it was a special aircraft made by Aichi. Allied intelligence obviously had no clue as to the mission Yamamoto had in mind for it.

Within the past few years, personal memoirs and interviews of the surviving Imperial Navy personnel involved in the Seiran and *sen-toku* projects have begun to appear in Japanese publications. Backed up by memoirs and chronicles by U.S. servicemen on the scene immediately after the war, these accounts collectively present a comprehensive history of the unique development and demise of the special task force who tried to realize Yamamoto's vision.

Along with long range and endurance for a deep strike mission from the sea, the maximum speed attainable to evade fighter interceptors was critical to the success of the all-or-nothing mission. Without floats, the aircraft

U.S. Navy crews who boarded an I-400 found the hangar empty, the airplanes having been launched into the sea.



NATIONAL ARCHIVES

戰備

# Team Seiran

*In terms of the challenges it posed to the staff at the National Air and Space Museum's Paul E. Garber Preservation, Restoration, and Storage Facility in Suitland, the Aichi Seiran is without peer. Here are the restorers' recollections of the project:*

**Bob Weihrauch:** When we got our first look at the floats, they looked in good shape from the top, but when we looked at the bottoms, we could see internal damage. It was all aluminum except for steel fittings where it attaches to the airframe. Dust and debris were falling out of holes in the skin.

We knew most of the work would be on the bottoms, so we turned the floats upside down and started removing the skin panels. We knew we couldn't just do a cosmetic repair because the aircraft would be displayed on its floats, so the floats had to be structurally sound.

Some sections had rivets that had completely turned to powder. The corrosion looked like it probably started on the inside and worked out. The float had probably filled with water—in fact, we could make out a water line inside it.

We took out the bad sections on one entire float and made wooden forms from the original parts. We used these to hand-form the replacement sections from .040-inch aluminum sheet. We annealed [softened] the aluminum and shaped it with a mallet.

We did 75 percent of the re-skinning job solo until we got to the keel, which is on top with the floats flipped the way they were. The access hatches that would normally be on top of the float were on the bottom where a person could crawl inside with a light and a fan and a whole bunch of bucking bars. Because of the location of some of the rivets, we had to fabricate bucking bars. Finally we got to where we had to have someone inside the float. A person can work about two hours in there before they have to come out. Once they were inside it wasn't too bad. But getting in was tough.

**Tyrone Stewart:** [I worked inside the floats] for about three weeks, and it was *hot* in there! The hardest part was near the end portions, where the float narrows. I had to crawl out, then climb back in again every time I needed to change my position.

**Bill Reese:** The engine was taken off the firewall and set vertically while we worked on it. It was fairly easy to remove. We pulled the cover off the bottom of the block to see the big ends of the connecting rods and crank. We looked inside the cylinders and saw that there was only a light coating of carbon, so it

had less than 10 hours on it. We went inside with a spray wand and some corrosion inhibitor and did some touching up here and there. There were no earth-shattering surprises. It was fun for me as a mechanic to work on such a rare engine. It's complicated, and it's a big chunk of metal—that made it a lot of fun. But curiosity is not a good enough reason to tear an engine completely down. You start tearing it down and you can do more damage than if you leave it alone.

**Matthew Nazzaro:** The fuselage had been outside most of the time, so it had sun and water damage. Souvenir hunters had been at it as well. There were areas where aluminum and steel were joined without coatings between them, setting up electrolytic corrosion cells.

**Robert McLean:** The first record of the [propeller spinner that accompanied the Seiran] was some photographs taken around 1960 when the aircraft was on display at an open house at the naval air station in Alameda, California. There is a mysterious blue spinner nose that didn't look right in these photographs, and later, during restoration, we found that this blue nose section didn't really fit the spinner base, leaving a gap. The shape didn't look right, the color was wrong, and rivet holes at the rear end of the spinner nose had no purpose.

Inside this blue spinner was penciled "RH" in an English or European alphabet, which suggests that this was not a Japanese spinner and possibly was the right-hand spinner of a twin-engine airplane.

**Nazzaro:** [After studying photographs] we decided that the spinner nose of the Suisei [the Japanese "Judy," similar to the Seiran] was longer than that of the Seiran, but the actual spinner bases from the two aircraft were identical. This provided us with an excellent starting point, knowing that all that was needed to plan the new Seiran replica spinner nose was an updated profile, with construction techniques based on the longer Suisei nose.

**McLean:** Using photo-interpretive techniques, a profile was developed and made into cardboard templates. These templates

were physically held up to the spinner base and the propeller hub temporarily mounted to the Seiran. We visually compared it to the photographs of the airplane, and we all agreed that it looked right. We then contracted to have a replacement spinner nose spun to those dimensions.

When we received a resin model kit of the Seiran and its highly detailed brochure, we saw factory drawings of entire sub-assemblies—the rear gun and how it moved, and the rear-seat articulation. Our volunteer, Hiroyuki Nagashima, remembered



*Garber staffers (above, left to right) Stevenson, Wood, Mawhinney, Heinzel, and McCombs; (below) Mautner, Weihrauch, McLean, Nazzaro, and Reese.*



CAMERON DAVIDSON (2)

building this model and found us another kit and had it delivered to the United States by a friend who came here on a visit.

*Nazzaro:* The model kit was the first important data milestone. After that it was like a flower opening; more information began to flow. There were still many mysteries about the airplane: brackets that you could only guess the purpose of, or large empty areas surrounded by fabric snaps.

*Karl Heinzel:* [The wing] was beat up and covered in cosmoline. The wooden wingtips were busted up and the sheet metal was bulged around where the spar was corroded.

*Anne McCombs:* One wing served as an example while the other was apart so we could always refer to it. It also had a lot of acorns in it, so obviously some squirrels had been in residence.

*Heinzel:* [Inside it] the interesting stuff was the drawings. A guy had written the alphabet in English with no letter L—there's no equivalent Japanese sound for L. There were some cartoon mice, a really nice geisha, a car, and two airplanes, one apparently on fire.

*McCombs:* There were numbers on each rib that would say "aircraft 12, rib 4" or just "12/4"—it took us a while to figure out.

*Heinzel:* Bill Stevenson welded in some patches, and the weld won't take unless the corrosion is completely gone, so you know that if the weld is okay, you removed all the corrosion.

*Scott Wood:* The original lens covers, the green and red lenses on the wingtip lights, were all busted up. I had to make a wooden mold in the shape of the lenses, so I taped the red one together to use for a pattern. I didn't have the right thickness of Plexiglas, so I wet-sanded it down to get the right thickness and then polished it. I took that finished piece and heated it, then shaped the heated plastic with hand seamers until it fit the wooden mold.

*Heinzel:* [During the corrosion cleanup] we had to build a box frame around the wing-stand assembly and cover it with plastic, then get inside and blast. So we're working in protective suits inside this enclosure to contain the dust, and someone painted some fish on the outside, so it looked like an aquarium with a guy in a diving suit walking around inside it.



ERIC LONG

Model M6A1 followed standard Japanese naval designation: M for special attack; the sixth in its development series; A for the manufacturer, Aichi; model number one. Most prominent in the fully restored front cockpit is the sight atop the glareshield, for bombing and launching torpedos. During restoration, missing instruments were replaced with those from the Museum's collection.

In 1944, the Japanese were fighting to defend what was left in *Sokoku* (ancestor's land). Performance and expediency, certainly not engineering elegance, had become the operative words of the military and industry.

had a maximum design speed of 348 mph. This was comparable to the top speeds of fighters like the Grumman F6F Hellcat: 380 mph. Even with floats attached, the Seiran attained a respectable maximum speed of 295 mph at an altitude of 17,160 feet, although it couldn't have outrun most fighters.

The Atsuta engine was a type 31 or 32 water-cooled, inverted V-12 rated at 1,340 horsepower (1,400 hp maximum), manufactured by Aichi and based on the German Daimler-Benz DB601A. The propeller, based on a Hamilton Standard, just cleared the inner diameter of the sub's hangar tube. The sub's hangar had facilities for heating the engine coolant and the lubricating oil. By pumping them into the aircraft's engine just prior to launch, the crew could warm it up without actually running it. Ultimately, the decision favoring the aerodynamically clean water-cooled engine over the larger diameter air-cooled engine prevalent in the Japanese aircraft of the time was based on the loading of the long, slender torpedo under the fuselage. The inverted V-12 engine ensured that the propeller arc was well forward of the torpedo's warhead.

Next came the task of tucking the aircraft into the 11.5-foot-diameter hangar tube. One of Ozaki's engineers came up with the idea of rotating the wings forward 90 degrees around the wing spar root and then folding them rearward against the sides of the fuselage. Unfolding the wings and connecting all the control-surface linkages and fuel lines from the wing tanks would have to be done in seconds to stay within the three to four minutes of an aircraft's launch preparation time. This operation was to be performed by four launch crew members on deck—most likely in darkness. The hydraulic wing-fold mechanism was powered by a source in the sub's hangar. The deck crew would connect a hydraulic line from the sub to a receptacle in the access panel under the fuselage at the wing root and power the unfolding actuators when the aircraft was clear of the hangar. All linkages, via various articulating mechanisms, were hooked up automatically. The deck crew merely had to hand-crank a set number of turns on the foldaway handles to seat the wing locking pins, two on each wing. Indicator arms, painted red and glow-in-the-dark phosphorescent, withdrew into the aircraft to show that the pins were set.

Three empennage tips, folded for hangar stowage, were flipped up and locked into place. The floats, when used, were mechanically rolled out of separate stowage tubes on both sides of the hangar tube as the aircraft

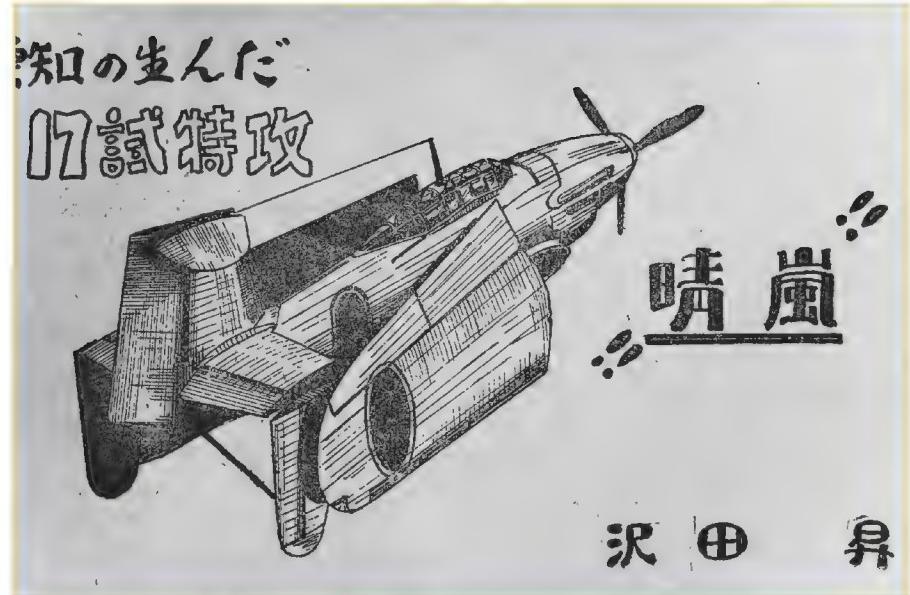
was emerging. They were snapped onto the pylons and then onto the underside of the wings with four quick-locking pins at each float's eight attach points.

The foldaway design continued inside. A 13-mm machine gun mounted behind the navigator's seat was stowed upside down in a recess in the fuselage and rolled right-side up into shooting position, facing aft to confront pursuers. For this manipulation, the aft end of the cockpit canopy was rolled upside down and away into the same stowage space below. In the up position the gun mount was hooked up to the gunner's seat and aimed by the gunner, who used a pedal to adjust the seat vertically.

As this was to be a dive bomber, it had to be equipped with an aerodynamic dive brake to control the speed and angle of dive. Ozaki's team employed a double-slot design that combined the flap with a dive brake, an idea Aichi had successfully developed for its carrier-based attack bomber, the B7A2 Ryusei (Allied code name "Grace"). The combination flaps extended fully to lower the landing speed to 78 mph. Only the smaller flaps deployed in the dive-brake mode at continuously selective angles down to the maximum 90 degrees. The pilot would select flap or dive brake mode and flip a switch at the top of the control stick while on approach or in dive bombing.

For the one-shot raid the Japanese navy would use the largest bomb in its inventory—the 1,764-pound general-purpose bomb with a steel penetrating head—or a 1,808-pound torpedo. The back seater's primary duty was precision navigation to the target and back to the sub. This navigator-bombardier-gunner would sit in a swivel seat, usually facing forward. His panel was equipped with a set of navigation and communication gear well beyond those of most Japanese single-engine bombers.

Aboard the submarine, the aircraft was mounted at four attach points to a dolly that rolled on a rail to the inclined catapult, then served as the launching shuttle during the catapult's 69-foot power stroke until the aircraft separated from the dolly and flew away. The launching dolly was equipped with an articulated support structure so that the aircraft would be in a low-silhouette squat position while in the hangar tube and, when rolled out of the tube onto the catapult track, would be tilted nose up for higher angle of attack during launch. The aircraft was launched in the same manner even when the floats were attached to the aircraft. The floats straddled the catapult ramp without touching the sides of the ramp or the deck surface below.



An informal sketch (the artist signed it at lower right) of the Seiran shows how its wings and tail folded.

As the aircraft design evolved early into adapting the detachable floats, a somewhat subtle but potentially significant consequence developed. Both the chief and assistant test pilots, Tadashi Funada and Yukitaka Murakami, were trained and experienced solely in floatplanes flying reconnaissance missions, not in bombers. So were the squadron commander, Lieutenant Atsushi Asamura, and the rest of the pilots assigned. The inexperience of the floatplane pilots in dive bombing and torpedo launching, along with the limited time available for developing the additional skills, reportedly led the unit to abandon the use of torpedoes. Further, in training and in mission planning, only a shallow dive was employed in attacks to get the best accuracy attainable within the pilots' limited expertise. This is ironic because the Seiran was one of the few aircraft in the world designed to be capable of both torpedo attack and dive bombing—besides being the first and perhaps the last sub-launched manned attack aircraft.

The Pacific war developed into the drawn-out match that Yamamoto had feared: It was a contest of national

wills, armed might, and, more critically to Japan, industrial capacity. The main theater of war soon contracted to the southwestern rim of the Pacific and drew ever closer to Japan's mainland. On a tour of Japanese naval bases undertaken in a desperate attempt to boost the morale of the troops holed up in the scattered last bastions of the crumbling Empire, Yamamoto's airplane was shot down by an American P-38. With the death of the brilliant strategist, the Imperial Japanese Navy lost the force of his vision to "reach" the U.S. mainland. But the rapidly changing war situation may already have rendered the operation futile.

In 1944, war production in mainland Japan was in a shambles. The Japanese were fighting to defend what was left in *Sokoku* (ancestor's land). Performance and expediency, certainly not engineering elegance, had become the operative words of the military and industry. Yet at the Aichi Aircraft Company, under the watchful eyes of the *Kugisho*, production of the M6A1 reached 28. Four I-400-class *sen-toku* were being built. The I-400 and I-401 entered service with their aircraft, and the I-402 was converted to a transport submarine. A fourth one was destroyed by a U.S. air raid on its shipyard.

On December 15, 1944, Number 631 Air Squadron was established, and on December 30, Number 1 Submarine Squadron. These units were intended to make up the special task force to carry out the Panama Canal attack. As U.S. forces drew closer to Japan, headquarters strategists began to abandon the Holy Grail of Panama, instead planning to send the attack group on a more essential mission: to strike at the U.S. naval task force readying for the inevitable assault on the Japanese mainland. Japan's intelligence marked Ulithi Atoll at the western end of the Caroline Islands as the target. The idea was not received well by the Yamamoto traditionalists, particularly Captain Ryunosuke Ariizumi, who, as one

*Nanzan*, a landplane version built for test and training, lacked the floatplane's vertical fin extension.



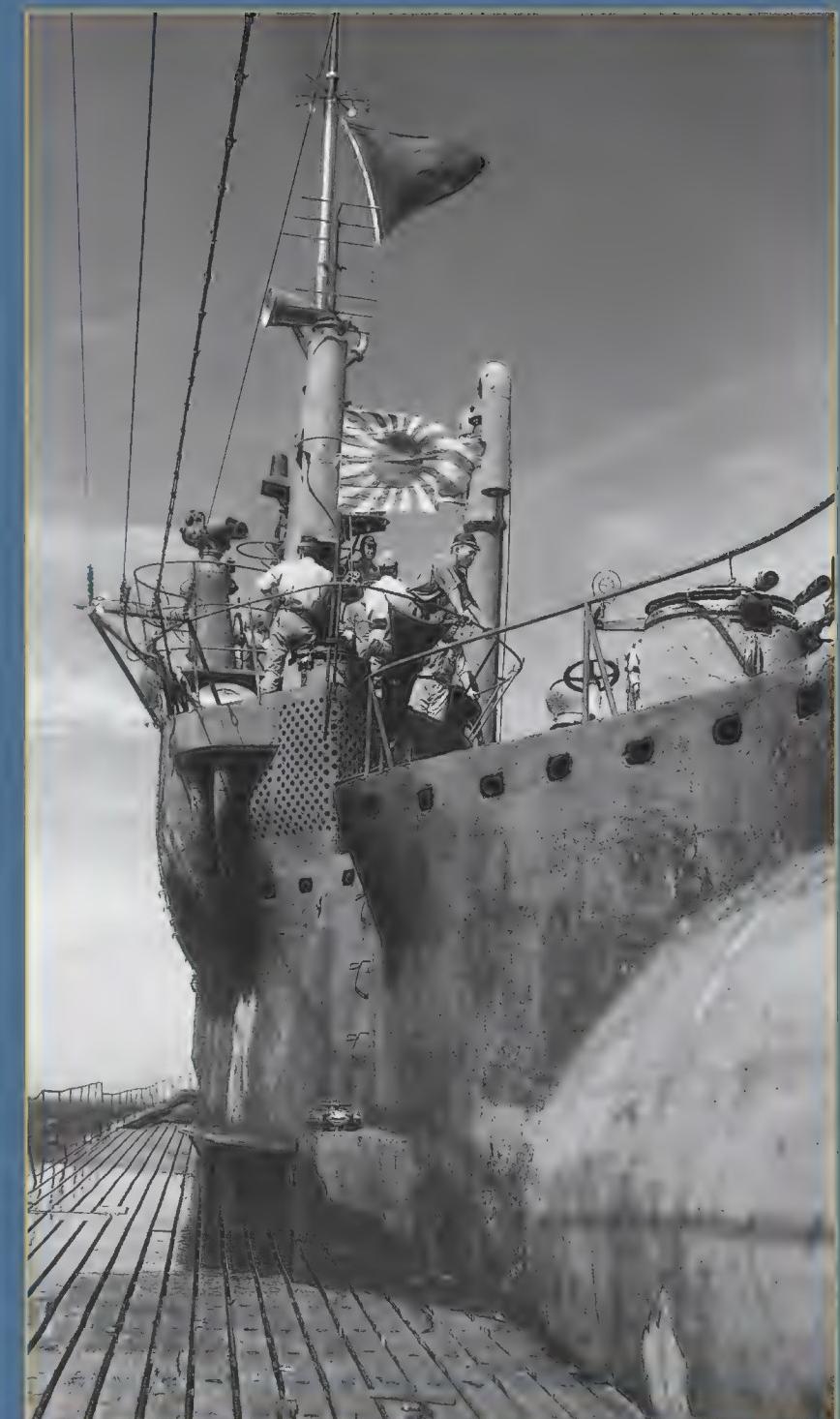


of the staff analysts in the Naval Operations Command, had endorsed the original Yamamoto proposal and was now assigned as commanding officer of the Number 1 sub squadron as well as commander of the entire *sen-toku* attack force. Ariizumi earnestly argued against reducing Yamamoto's strategic vision to a mere tactical stroke and pleaded to high command, but to no avail. The target of the *sen-toku* force mission was changed officially from the Panama Canal to Ulithi Atoll on June 25, 1945, when the order was passed to the units in training for the mission to return to home port.

The Ulithi operation consisted of two elements: Operation *Hikari* (Light) ordered I-13 and I-14 submarines to transport two *Saiun* (Nakajima C6N1, Allied code name Myrt) advanced reconnaissance aircraft aboard each ship to Truk, an island base still held by Japan approximately 900 miles east of Ulithi in the Carolines, to conduct reconnaissance flights to verify the presence of the U.S. fleet. The *Saiuns*' high-speed, high-altitude, long-range performance were called for in this mission to ensure success of the valuable *Seiran* attack force—to be launched in unrecoverable float-less configuration. The I-13 hangar designed for two big *Seirans* was large enough for this big, three-seat reconnaissance airplane equipped with a 2,000-hp Homare engine and developed as a carrier-based aircraft. The two ships, having replaced the *Seirans* with *Saiuns*, left Maizuru on July 2. The I-13 never made it to Truk; it was reported missing and later confirmed sunk by a U.S. destroyer.

The plan for Operation *Arashi* (Storm) was, true to the *Seiran* name, to rain storms of attack on the U.S. fleet from the southern sector, where no Japanese force was known to exist. Six *Seirans*, three aboard Ariizumi's I-401 flagship and three more on the I-400, thus constituted the final one-shot attack force.

There was a solemn send-off ceremony on July 19 in Maizuru—a ceremony that had become an increasingly frequent routine in the Japanese navy and army air forces in the last days of the war, as pilots of *Tokko Tai* (Special Attack Corps) readied themselves for their final sortie. The 12 crewmen of the six *Seirans* were each presented with a dagger in an unlacquered wooden scabbard—a *samurai* warrior's personal weapon that has not drawn blood—as a symbol of prayer for success in their last and highest mission of honor. The daggers were sent by the sixth fleet commander in chief and personally handed out by Ariizumi. These gifts expressed an unspoken expectation that each *samurai* would not hesitate to make the final dive of his aircraft and dash himself and his comrade into the enemy target to ensure the success of the mission in defense of the "ancestor's land." That these missions were *tokko* (special attack), called "kamikaze" by Westerners, was solemnly understood by the flight crew, the commanders, and the nation. It may not have been written in the order of the battle, but it was implicit in the prevailing doctrine of battle, the sacred ritual, and the mounting urgency of the homeland defense. For the first time in the *kenkon itteki* strategy that had produced the one-mission aircraft designed for



NATIONAL ARCHIVES

Upon cessation of hostilities, Japan's submarines were ordered to surface and fly black triangular pennants (above). The attack flotilla had assembled at Kure, then moved to Nanao Bay for training but soon returned to the Maizuru naval base. In July 1945, the group moved to a harbor at Ominato before slipping out to sea on Operation Hikari.



The plan for operation “*Arashi* (Storm)” was, true to the Seiran name, to rain storms of attack on the U.S. fleet out of the southern sector, where no Japanese force was known to exist. Six Seirans, three aboard Ariizumi’s I-401 flagship and three on the I-400, thus constituted the final one-shot attack force.

maximum effect, the mission became a truly one-way *tokko* attack. The world’s only sub-aircraft carrier attack force left for its final mission from Ominato, the hastily assigned home port at the northern tip of Honshu.

Published accounts, recently confirmed, of the preparation for the Ulithi attack alluded to the red *hinomaru* (the sun circle of the Japanese national flag) marking of the Seirans being painted over with the star markings of the U.S. forces. Another account, that the aircraft were repainted in the silver color predominant among U.S. aircraft, has not been confirmed in the recollections of those present. In a 1999 interview with National Air and Space Museum restoration specialist Robert McLean, Murakami, the *Kugisho* test pilot who had performed the final flight check of the Seirans at Maizuru base, remembered his astonishment and shame when he saw the U.S. star on the folded wing of a Seiran on the deck of an I-400 submarine. He could hardly believe that the Imperial Japanese Navy would resort to such deception. Asamura, the 631st squadron’s flight leader, told McLean that “the Ulithi attack was a ‘one in thousands’ chance.” If mistaking the Seirans for P-51s could cause the American defenders to hesitate for one second, he continued, at least one or two aircraft may be able to get through to hit an American warship. “Thus the intense desire to succeed in the slim-chance attack overrode the shame of the acknowledgedly ‘cowardly’ tactic,” Asamura said.

On August 15, 1945, even as the elements of the force headed toward their rendezvous point for attack, Emperor Hirohito announced Japan’s surrender to the Allied powers. The submarines were instructed to disarm and return to their home ports, cruising on the surface and flying a black triangular flag in accordance with the surrender agreement. The special force’s main weapon systems, the revered Seiran M6A1s, were scuttled—launched, with wings folded, from the I-400s’ catapults to sink into the depths of the Pacific.

And so the product of Admiral Yamamoto’s elaborate strategy to bring the war to the U.S. mainland came to an end. Captain Ariizumi took his own life in his command ship’s cabin, observing an ancient tradition when faced with the dishonor of surrender, a concept that is not in the vocabulary of the *samurai*.

The *sen-toku* submarines were sailed to Pearl Harbor by a U.S. Navy crew for technical assessment and were subsequently scuttled at sea off Hawaii. The submarines, I-401, I-400, and I-14 followed their aircraft to the deep.

The chaotic aftermath of Japan’s surrender and the



NASM

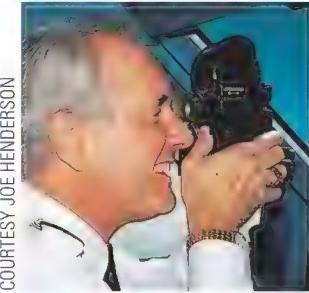
*Seiran number 28, the last of its line, spent many years in storage before it was shipped to the National Air and Space Museum’s Garber Facility for restoration.*

hasty collection and shipment to the United States of samples of Japanese warplanes by the Allied Air Technical Intelligence Group revealed no special notice of the heretofore secret aircraft. Fortunately, the shipment included at least one Seiran, which eventually found its way to Washington, D.C., to be preserved as the only remaining example in the world.

The I-400 *sen-toku* had been the largest submarine in the world ever to sail until the U.S. Navy launched the nuclear submarine USS *Triton* in 1959. Author E. John Long, in the October 1953 issue of *Ships and the Sea*, described the first U.S. encounter with the *sen-toku*: “Twelve days after the Mikado told his people to lay down their arms, one of Japan’s most closely guarded secrets was revealed. The pilot of the U.S. Navy patrol plane could scarcely believe his eyes. The great dark object, half awash, looked like a floating wreck. It seemed too big to be a sub—but it *was* one, on the lam.”

Recently, the staff at the Paul E. Garber Preservation, Restoration, and Storage Facility in Suitland, Maryland, completed a lengthy restoration of the surviving Seiran (see “Team Seiran, p. 26). While searching records in Japan, staff members met individuals involved in the design of the airplane, and they were able to tell their stories. The restored Seiran will re-tell the story for years to come.

# How Things Work:



# Celestial

by Joe Henderson | Illustrations by John MacNeill

The Airbus A330 that I fly across the Atlantic to any of several European cities is equipped with onboard navigation computers that tell us in the cockpit exactly where we are at any time.

But when the routes I fly were pioneered some 60 years ago, computers and Global Positioning System satellites weren't on hand to help pilots find their way across oceans at night. In my flight bag is a World War II-vintage Pioneer-Bendix bubble sextant, which I use—just for fun—to see how close those earlier navigators could come to the position fixes now provided by our sophisticated navigation equipment. I try to imagine what it was like to stand in the bubble window protruding into the slipstream from the top of those old transports and figure a position from the stars.

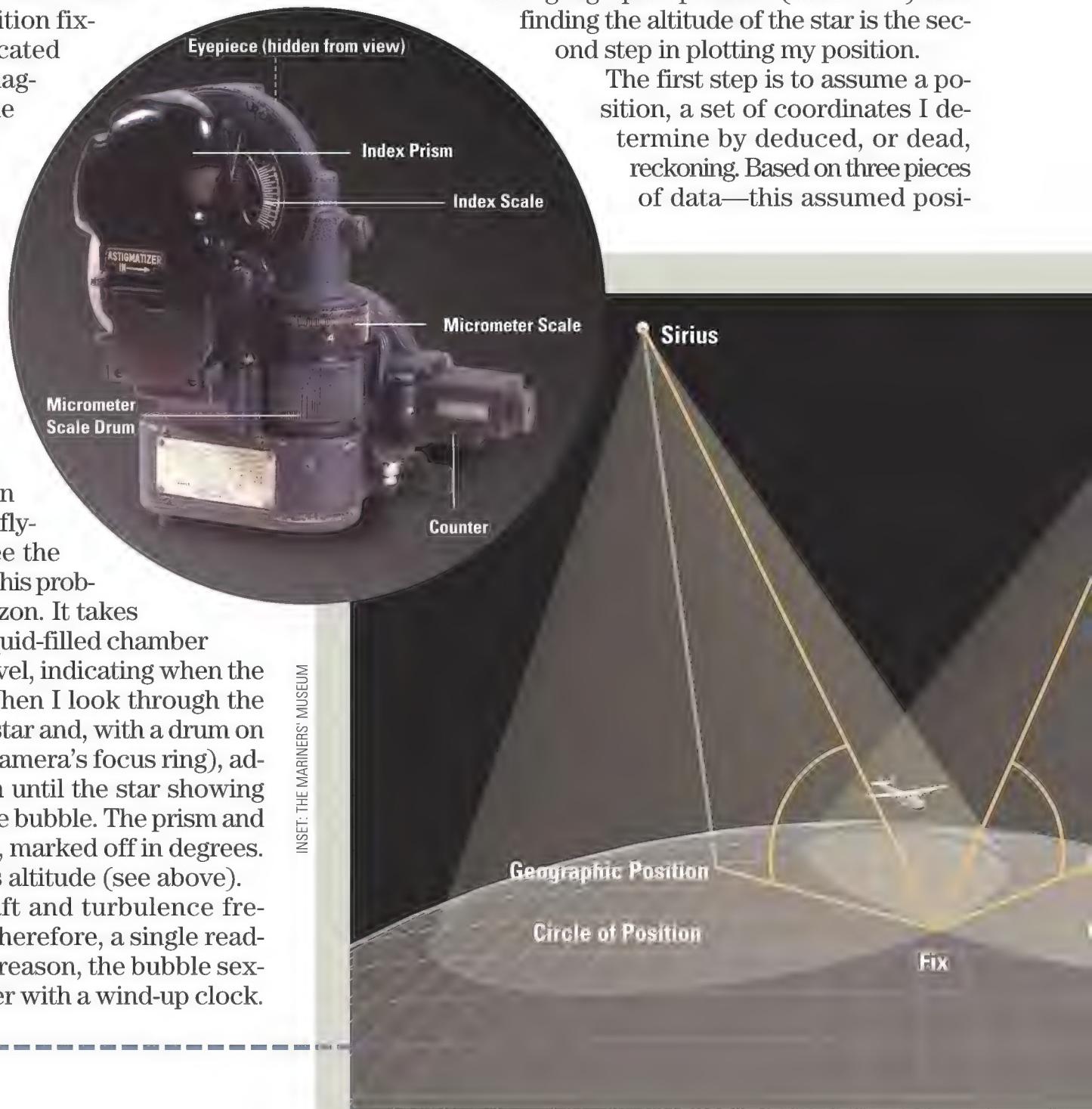
A sextant is used to measure the altitude of a celestial body above a horizontal line of reference. ("Altitude" in this case is a special use of the word describing an angular measure, not a distance in feet above sea level.) A mariner can use the horizon as this line of reference, but when an airplane is above the clouds or flying at night, its navigator can't see the horizon. The bubble sextant solves this problem by providing an artificial horizon. It takes its name from an air bubble in a liquid-filled chamber that functions like a carpenter's level, indicating when the sextant is aligned horizontally. When I look through the eyepiece of my sextant, I locate a star and, with a drum on the side of the instrument (like a camera's focus ring), adjust the angle of a rotatable prism until the star showing in the eyepiece is aligned beside the bubble. The prism and drum are geared to circular scales, marked off in degrees. From these scales I read the star's altitude (see above).

But acceleration of the aircraft and turbulence frequently deflect the true vertical; therefore, a single reading may not be accurate. For that reason, the bubble sextant also has a mechanical averager with a wind-up clock.

It takes 60 altitude readings over a two-minute period, using a little counter that looks like a car's speedometer to average and display the measurements.

Once I know the star's altitude, I can find where I am on an imaginary line extending from me toward the star's geographic position (see below). But finding the altitude of the star is the second step in plotting my position.

The first step is to assume a position, a set of coordinates I determine by deduced, or dead, reckoning. Based on three pieces of data—this assumed posi-



INSET: THE MARINERS' MUSEUM

# Navigation

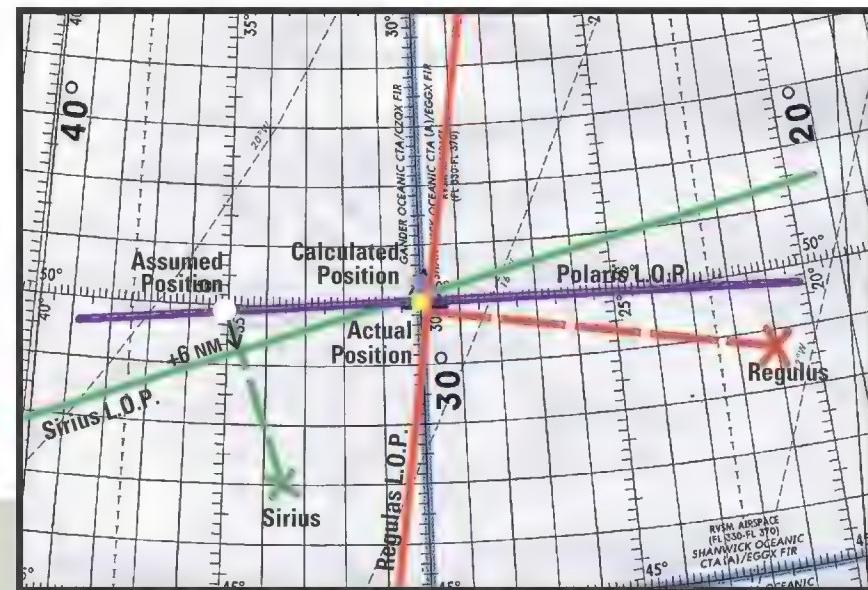
tion, the altitude of the star, and its azimuth (its angular distance from true north), I calculate where I am by proving that I'm not where I assumed! Here's an example:

Last January 9, at 02:30 Universal Time, I assumed that I was at latitude N $50^{\circ}$  and longitude  $30^{\circ}53.9'W$ . With my sextant, I measured the altitude of the star Sirius to be  $22^{\circ}11'$ . I then went to *The Nautical Almanac*, where a number of tables helped me compute the declination (similar to latitude) and Greenwich Hour Angle (similar to longitude) of Sirius on the celestial sphere for that time at that date. With more formulas and tables (there are about eight steps in all), I calculated the altitude of Sirius to be  $22^{\circ}05'$ . Since my observed altitude of Sirius was 6' greater than the altitude calculated for the assumed position, my true position must be 6' closer to Sirius' geographic position (see chart, right). Next I drew what is known as a "line of position" perpendicular to the azimuth of Sirius, and then I started the whole process over again with the star Regulus, and again with Polaris, which, as the North star, is a special case. The intersection of three lines of position gives a fix.

After all this, how close to the actual position do I get? You can see from the chart that my calculated position—

in the triangle formed by the intersection of three lines of position—is only about five nautical miles away from the actual position, given to me by the aircraft's navigation system. On our North Atlantic plotting charts, 10 nautical miles is about a sixteenth of an inch. At our ground speeds, that size circle of error puts us within one to one and a half minutes of the exact position.

The process of navigation may be complicated, but its concept is simple. As my mom, now 82, puts it, "It's when you leave home, you know how to get back."

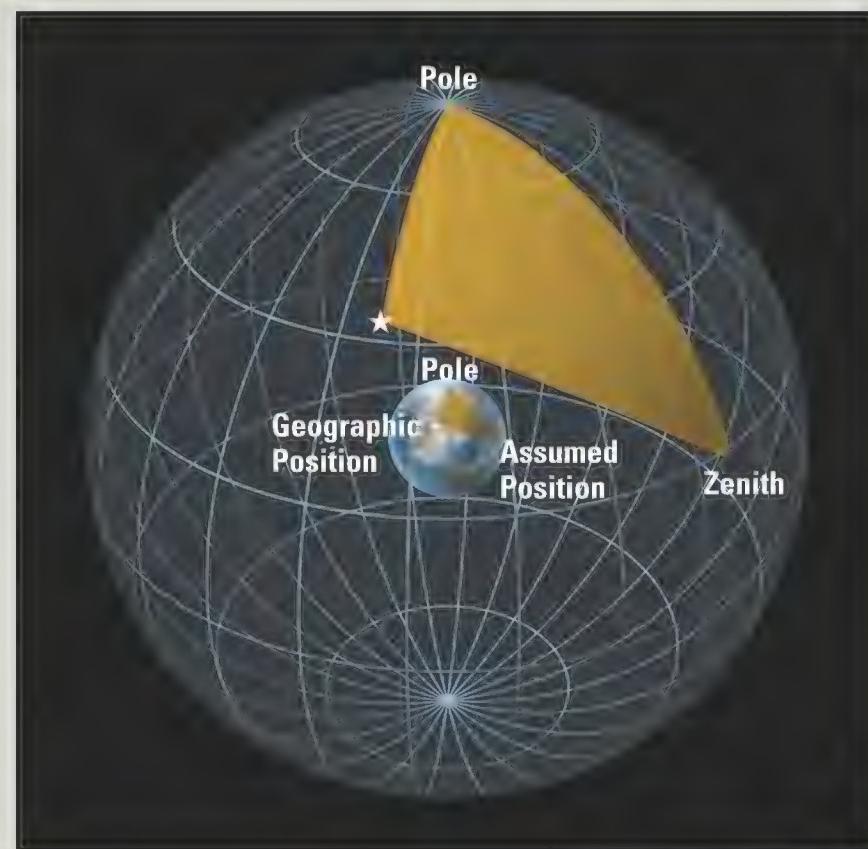


COURTESY JOE HENDERSON



To describe the locations of celestial objects, astronomers imagined a celestial sphere, whose surface is of infinite distance from the Earth. Early navigators used the sphere to plot a navigational triangle (right), the points of which coincide with the celestial body, the elevated pole, and the zenith, a point directly above the observer. Using spherical trigonometry, the navigator solved the angle at the pole, and from that could calculate his longitude. By referring to charts that gave the star's angular distance from the celestial equator, or declination, and determining the angle at the star, he could pinpoint his latitude.

Modern navigators have it easier. They find the altitude of a star and know they are somewhere on a circle, where from every point the star is the same angle above the horizontal (left).



In 1968, a stark cement building slowly took shape on the grounds of an optical manufacturing company called Perkin-Elmer, which sits on a hill in Danbury, Connecticut. The cavernous building was made especially for secret military programs, including the construction of cameras for KH-series spy satellites. Such work capitalized on the company's expertise—grinding and polishing disks of glass or metal into optical mirrors.

Veteran optical physicist Terence Facey leans back in his chair and declines to elaborate on what was done in the facility from 1968 to 1975, before the company turned its skills toward manufacturing the mirrors for the Hubble Space Telescope.

"It was classified work. Period," he says politely.

Facey is a London-educated physicist, a thin, white-haired man whose manner and accent give him an air of timeless wisdom. He could easily be cast in a science fiction film as a sage.

Facey has worked at this facility for 34 years and has watched its name change from Perkin-Elmer to Hughes Danbury Optical Systems to Raytheon Optical Systems to, this year, Goodrich Optical and Space Systems Division. The name has changed so many times that those in the optics branch simply refer to the factory as "Danbury."

Major government-funded optical programs do not come along very often, whether they are top-secret programs or purely scientific efforts. That is why Facey is sitting in a conference room now, talking about why Danbury should be the mirror maker for the \$1 billion Next Gen-

**MIRROR**  
by Ben Iannotta  
The fight is on  
for the chance to build the  
world's most advanced  
space telescope.

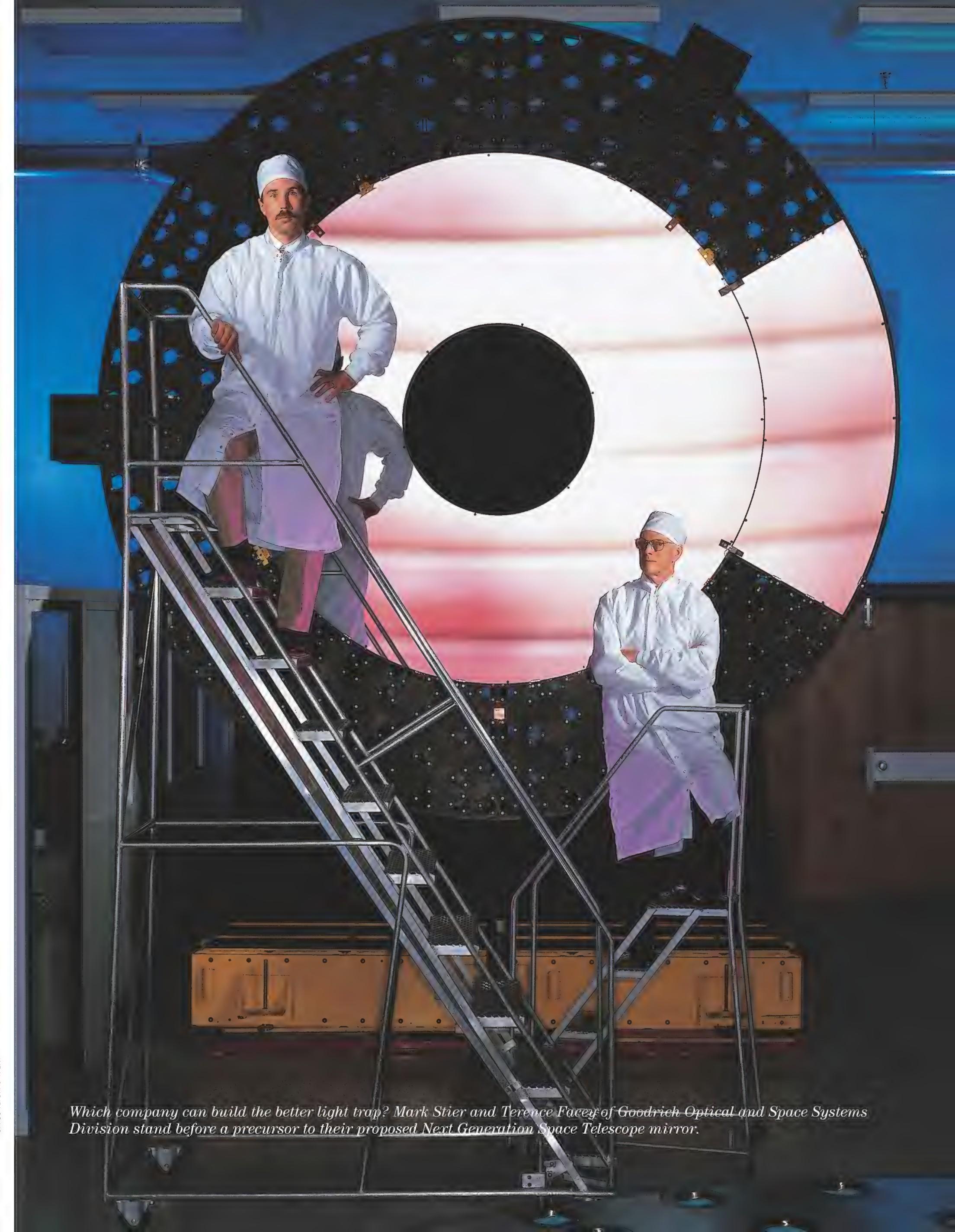
eration Space Telescope. When the NGST joins Hubble in space, it will have the largest mirror ever deployed, at least as far as non-classified vehicles are concerned.

The telescope will be stationed not in low Earth orbit like Hubble but a million miles from Earth, at a so-called Lagrange point, where the pull of the Earth and that of the sun are in equilibrium. Here, after a 104-day trip to Lagrange point 2, a mirror six to seven meters (about 20 to 23 feet) across will catch faint infrared light waves emitted by clouds of gases during the first billion years after the Big Bang.

"What did galaxies look like before they were born? This telescope will tell us that, and that's really exciting," says astronomer Alan Dressler of the Carnegie Observatories, an organization that operates ground-based telescopes in Chile and California.

Unlike many of Hubble's pictures of relatively nearby galaxies and stars, he says, "the images have the potential to be visually stunning and things we've never seen."

John C. Mather, an astrophysicist at NASA's Goddard Space Flight Center in Maryland, says that between measurements of cosmic background radiation and observations of young galaxies lies a cosmic "dark ages"—a period in the formation of the universe as yet unseen. Mather, who used the Cosmic Background



*Which company can build the better light trap? Mark Stier and Terence Facey of Goodrich Optical and Space Systems Division stand before a precursor to their proposed Next Generation Space Telescope mirror.*



is funded jointly by NASA, the Air Force, and the National Reconnaissance Office, which operates spy satellites. The three companies each received about \$3 million to build competing versions of lightweight mirrors and test them in vacuum chambers.

Each contractor will have to show that mechanical actuators on the back of the mirror can adjust the instrument's shape, or "figure." Phasing experiments, in which the contractors will prove that different segments can work together without losing focus, will come later.

For the contractors, the creation of the Hubble's primary mirror provides a benchmark and, of course, a cautionary tale. It was here at Danbury, back in 1980, that Hubble's primary mirror was ground and polished very precisely to the wrong specifications. The mirror's curve was off by just one-fiftieth of the width of a human hair, but that was enough to spread Hubble's light across multiple focal points instead of one. Here is the plot twist: The engineers and physicists at Ball, Danbury's rival in Colorado, are the same happy few who stepped in to build the optics that corrected the images bouncing off Hubble's flawed mirror.

Danbury officials deny that the real reason they are chasing the NGST contract is to

*Inside Ball Aerospace's optics test facility, engineer Doug Neam and astronomer Douglas Ebbets evaluate hexagonal mirror segments beneath a 30-foot test rig.*

Explorer to confirm the existence of background radiation left over from the Big Bang, looks to NGST to provide insight into the period when the universe was between about one million and a few billion years old—when galaxies and stars began forming.

Last June, NASA released the ground rules for the competition to build the NGST spacecraft and instruments. The company that wins the competition will then decide who will build the telescope's mirror: Ball Aerospace in Boulder, Colorado, Goodrich in Danbury, Connecticut, or Eastman Kodak in Rochester, New York.

The three companies have been experimenting with different mirror materials through a \$20 million project called the Advanced Mirror System Demonstrator (AMSD), which

redeem the company's reputation. Facey insists the Hubble error was an "anomaly" in a long list of groundbreaking company triumphs, which includes the new Chandra X-ray observatory and the soon-to-be-launched Space Infrared Telescope Facility. Chandra is giving astronomers unprecedented information about black holes, and SIRTF will obtain images of not only the early universe but also planets in our solar system and the cosmic dust and gas surrounding nearby stars.

Ball, Danbury, and Kodak have teamed up with California-based aerospace giants that know how to integrate sensitive optical equipment and powerful satellite frames. Danbury is working with Lockheed Martin of Sunnyvale, and Ball and Kodak are joined up with TRW of Redondo Beach.

But the prime NGST contractor must select the best mirror, regardless of any teaming arrangements—otherwise, NASA won't approve the design.

Out in Boulder, in the same low-slung buildings at the foot of the Rocky Mountains where Hubble's corrective optics were built, members of the Ball team make it clear that the competition is a fierce one.

Unlike Danbury, Ball—the same company that made your grandmother's canning jars—is not known as a maker of large optical systems like Hubble's primary mirror, let alone one that would be 10 times bigger. Its niche has been the design and manufacture of small scientific instruments. It made most of the instruments and cameras that sit behind Hubble's main mirror, converting raw light from the mirror into pictures of the heavens. Because of schedule delays, Ball got the nod to build the SIRTF telescope and instruments through subcontractors after NASA halted Danbury's work on that telescope's 4.9-meter mirror.

NASA officials want the NGST mirror to be six to seven meters wide. A mirror that size could not possibly be ground from a single piece of glass, the way Hubble's 2.4-meter mirror was, and must be made from segments. In order to stay within the telescope's 6,600-pound payload limit, these need to be seven to 10 times lighter per square meter of surface area than Hubble's mirror. NASA wants the new mirror to weigh no more than 44 pounds per square meter.

The size of the mirror—more than double that of Hubble's, larger than any conceived of for a spacecraft mirror—started as a bold challenge from NASA Administrator Dan Goldin. In January 1996, Goldin stood up in front of the American Astronomical Society in San Antonio, Texas, and flabbergasted the audience by calling for the Next Generation Space Telescope to be built with a mirror eight meters across.

Carnegie's Alan Dressler remembers sitting in the audience. He had just finished leading a meeting of astronomers who hoped to whet NASA's appetite for a successor to Hub-

ble. The Dressler Committee report, "The Hubble Space Telescope & Beyond," called for a telescope with a mirror at least four meters across, or two-thirds wider than Hubble's—half the size of Goldin's proposed mirror. Dressler figured that was about the right size to magnify infrared waves and capture images of the very early universe. A bigger telescope would improve the resolution of the images somewhat, but the main goal was to get a mirror to the Lagrange point, far from Earth's heat, where the infrared waves would stand out against the cold background of space, he says.

To reach space, the mirror will have to be sent atop an unmanned rocket, folded up like the leaves of a table or the petals of a flower. It must unfold in space without jamming. Then it has to hold its shape for 10 years in temperatures close to -457 degrees Fahrenheit, the point at which matter no longer has any thermal energy.

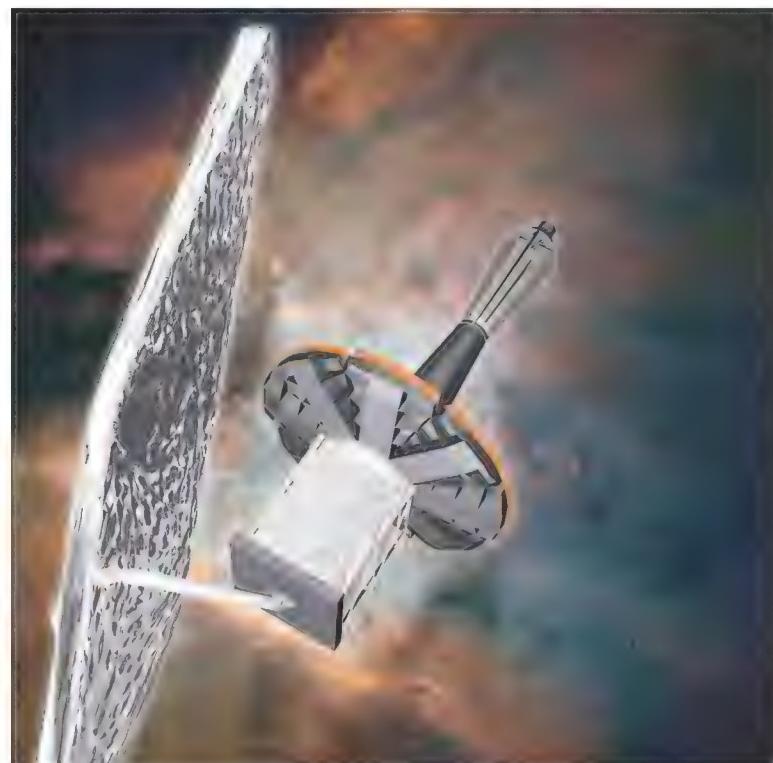
Engineers aren't entirely sure what the extreme cold will do to the segments, and flaws invisible to the naked eye would blur the telescope's images. The mirror will be supported by numerous tiny, electrically controlled mechanical arms, called actuators, which will, in a technique called adaptive optics, nudge each segment into place after deployment. Then, perhaps once a month, NGST will look out to a reference star. If the image is blurry, ground controllers will send commands up to the telescope to nudge the mirror segments back into place.

The project is so daunting that the potential contractors are relieved that NASA has reined in the program slightly. Earlier this year, agency officials signaled their willingness to settle for a telescope of six to seven meters instead of eight.

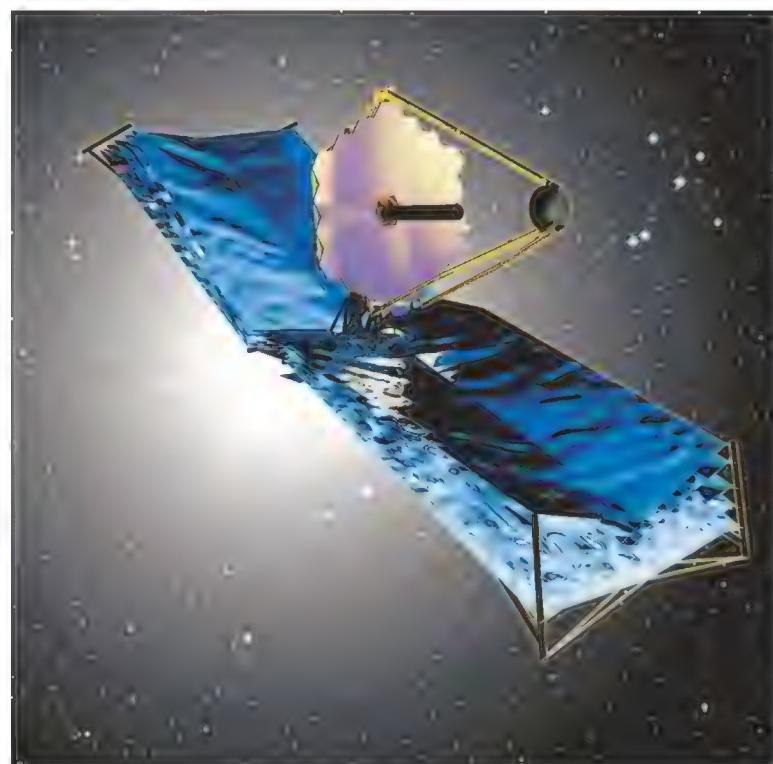
On the other hand, some astronomers are convinced that bigger is better, and they completely support Goldin's vision of an eight-meter NGST mirror.

"In the early universe, there was a time when the first stars and star clusters lit up and illuminated the world, so to speak," says astronomer Simon Lilly of the Herzberg In-

*The Danbury mirror features eight petals, each of which will be shaped by 50 tiny actuators working in the absolute cold of space.*



COURTESY LOCKHEED MARTIN



COURTESY BALL AEROSPACE

*Ball Aerospace and Kodak favor a main mirror—glass or beryllium—integrated with deployable auxiliary segments.*

stitute of Astrophysics in Victoria, British Columbia. He worries that a smaller mirror will produce degraded image quality and necessitate additional observation time. "We tried to design NGST so that observing that epoch is within its grasp," he says. "For that, we need every little bit of sensitivity we can get. The bigger the better."

Mather agrees there are significant advantages to a larger mirror. "Since the aim is to see the first light from the first objects that formed after the Big Bang, we don't want to spend a year taking data with a four-meter telescope that would have taken less than a month with the eight-meter," he says. "This is such a big difference that we don't think the four-meter telescope will be able to see what we want to see.... We are pretty sure that a four-meter telescope would take 16 times as long to collect the light from a primordial galaxy as the original eight-meter concept would have done.... We can partially compensate for having a smaller telescope by getting more and better detectors."

However, Dressler thinks a mirror with a minimum diameter of four meters would do just fine. He is nervous that NASA might be pushing the technology too far, which could leave astronomers with a flawed telescope or one that devours NASA's astronomy budget as agency contractors try to reconcile the various elements required of the NGST mirror.

In Rochester, New York, another traditional American company with a homespun reputation is hoping to solve the puzzle. Kodak is the "dark horse" in the race, says Bernie Seery, NASA's NGST program manager. "But the company is aggressively engaged in the selection process and is a formidable competitor." Although Kodak is on the same team as Ball and will share a portion of the work if TRW is selected to build NGST, Kodak is still in competition with Ball to provide the mirror. Kodak engineers are working with a familiar concoction of melted silica used in the company's cameras since the first Brownie. "Glass has been a traditional mirror material, so a lot is known about its manufacture," says Jeffrey Wynn, general manager of space science in Kodak's commercial and government systems division.

Kodak's engineers hope their method of fashioning the mirror will result in one that is lighter and less expensive than a conventional glass mirror. "Ours is a little bit different," says Wynn. "It's a semi-rigid design constructed of a glass core section that looks like a honeycomb." Glass is fused into a top and bottom plate while the mirror blank is still flat. "Then we slump it over a mandrel [a metal mold] and shape it."

Such an approach eliminates much of the labor-intensive manufacturing processes usually required in building glass mirrors. "It's much easier to work on mirrors in the flat than in steep curvatures," says Wynn. "That's what takes a lot of time—the steep curvatures in large parabolic mirrors have to be perfect, and the most laborious parts in generating those curves are the machining operations and the polishing."

Kodak's AMSD experience produced a mirror in the ultralight range of less than 33 pounds per square meter, far lighter than Hubble's massive 330-pound-per-square-meter mirror. Because of the size needed for the NGST mirror, Wynn hopes Kodak's manufacturing techniques will prove that glass is the right choice.

But besides the choice of materials for the mirror, nearly every aspect of the telescope will prove difficult to create.

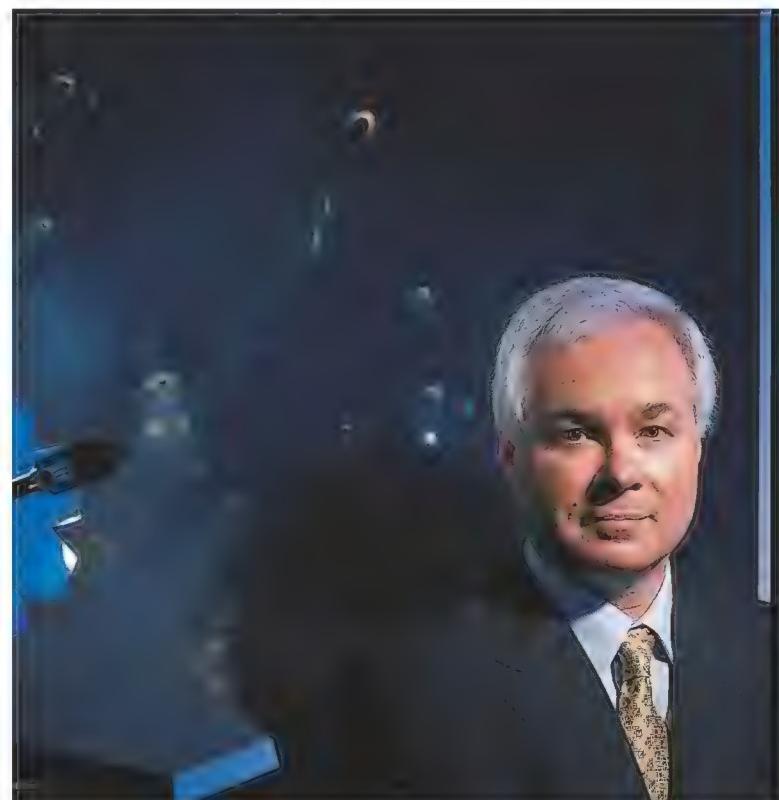
"You've got to push people to do the very best they can, and at some point you've got to say 'Okay...now I've got to really build it,'" Danbury's Facey says. He notes that the same thing happened with the Hubble, which was originally slated to have a three-meter mirror.

Inside Danbury's mirror manufacturing facility, Facey points to a giant 4.3-meter mirror that is resting horizontally on a metal support. He says it weighs 7,000 pounds and must be moved on a cushion of air.

NGST will be nothing like that. Under the current design, Danbury would fabricate nine segments that would be less than 20 millimeters thick—about two-thirds of an inch. They will be, in a word, flimsy. "You breathe on this thing and it's going to change," Facey says.

Danbury's design calls for a central mirror that would be shaped like an octagon. Keystone-shaped segments would extend out from each flat side of this central mirror to create one large surface. The keystones would be hinged so that one could be folded forward, the next aft, and so on, around the central mirror. That is how the engineers plan to squeeze it inside an unmanned rocket's payload shroud. The tolerances will be tight—Danbury engineers have spent a considerable amount of time studying the lessons of the Hubble program, in which the error resulted from engineers relying on a single measuring tool, which turned out to be flawed.

And the complexities of the mirror itself are greater. In contrast to Hubble's single-piece mirror, Ball's initial blueprint calls for 36 segments. Each must stay perfectly matched to the surrounding segments or the mirror's delicate focus will be lost. That job will be more complex with more segments, Facey says. "It's not a non-trivial issue to poke those optics



CAMERON DAVIDSON

*NASA's Bernie Seery oversees production of hardware for catching the universe's first light.*

with a couple hundred actuators and still get something that looks good," he observes.

It does not take long to realize that each company has a radically different opinion about how many segments will be needed to make up the NGST mirror. Danbury figures at most nine, including the central mirror; Ball figures up to 36; Kodak's AMSD mirror, while not strictly a prototype of its NGST design, uses 19.

Ball engineers are eyeing beryllium, the same metal that Danbury had so much trouble using for SIRTF's primary mirror. It is highly reflective and would need no special coating. Glass mirrors, on the other hand, are coated with gold to make them reflective.

Beryllium, unlike glass, is not available in large disks, so a large beryllium telescope would have to be assembled from lots of smaller pieces. Yet the Ball team remains tempt-

ed by beryllium because it is much stiffer than glass, says Doug Neam, a former college wrestler who is now Ball's NGST program manager. "One of the fundamental building blocks of this program is how you will get a mirror of extremely lightweight design," he says. "That's what got us into looking at beryllium mirrors." Neam gestures toward a model of Ball's proposed NGST mirror. "If you look at the back of this mirror here you will see that the actual face sheet is just a couple of millimeters thick. And then the mirror itself is a couple of inches thick. Call it 50 millimeters-ish," he says. The model is not to scale, but his point is that a beryllium mirror would be much lighter than an equivalent glass mirror.

Despite all the potential advantages, Ball astronomer Douglas Ebbets cautions that Ball has not yet ruled out glass. "That final decision won't be made for another year, pending the outcome of tests of mirror technology developments that are currently under way," he says.

Engineers at Danbury say they know a thing or two about beryllium. In fact, they are openly resentful about the credit Ball engineers appear to be taking for SIRTF, which operates with a mirror fabricated in Danbury. "The bottom line is they're flying the hardware that was made, in part, with these hands right here," says Mark Stier, a blunt-speaking astronomer whose job, if Danbury wins the contract, would be to oversee the assembly of NGST's mirror system. "There are only two places in the world where beryllium mirrors are made; this is one of them," he says.

Stier is doubtful the metal is the first choice for the NGST mirror. The problem with beryllium is that its crystalline

structure is not the same in all directions. "[The crystals] tend to expand more in one direction than another," Stier says. "It's not as homogenous as glass." When beryllium hits the cold of space, it will shrink. "The mirrors would probably change their shape more when you cooled them than you would desire," Stier says.

The Danbury team's hard-won experience with SIRTF's beryllium mirror has influenced the direction its NGST mirror is taking. "Did we have a hard time with [beryllium]? Yes. Are we concerned about beryllium? Yes. But that was not the determining factor in terms of our decision," says Ira Schmidt, who managed the company's Chandra program and is now in charge of the NGST work. "We know some of the idiosyncrasies of beryllium that maybe our competitors don't know," he adds.

But for both Danbury and Kodak, the more traditional material—which was used to fashion the Hubble's mirror—will most likely be chosen. "We believe that glass works fairly well at cold temperatures," says Kodak's Jeffrey Wynn. "And programs like the space-based laser [prove] that glass stays in shape, depending on the application."

And there is another huge advantage to glass. "Look at how many skyscrapers have large windows of glass," Terence Facey says. "Glass is a well-understood material available in almost any size you want." That is why the Danbury team believes that it can build the mirror from just nine segments, compared with the Ball team's 36.

And Wynn thinks that a decision on the NGST mirror may not spell the end of the two options that aren't selected as the final design. "Three different types of technology are still in

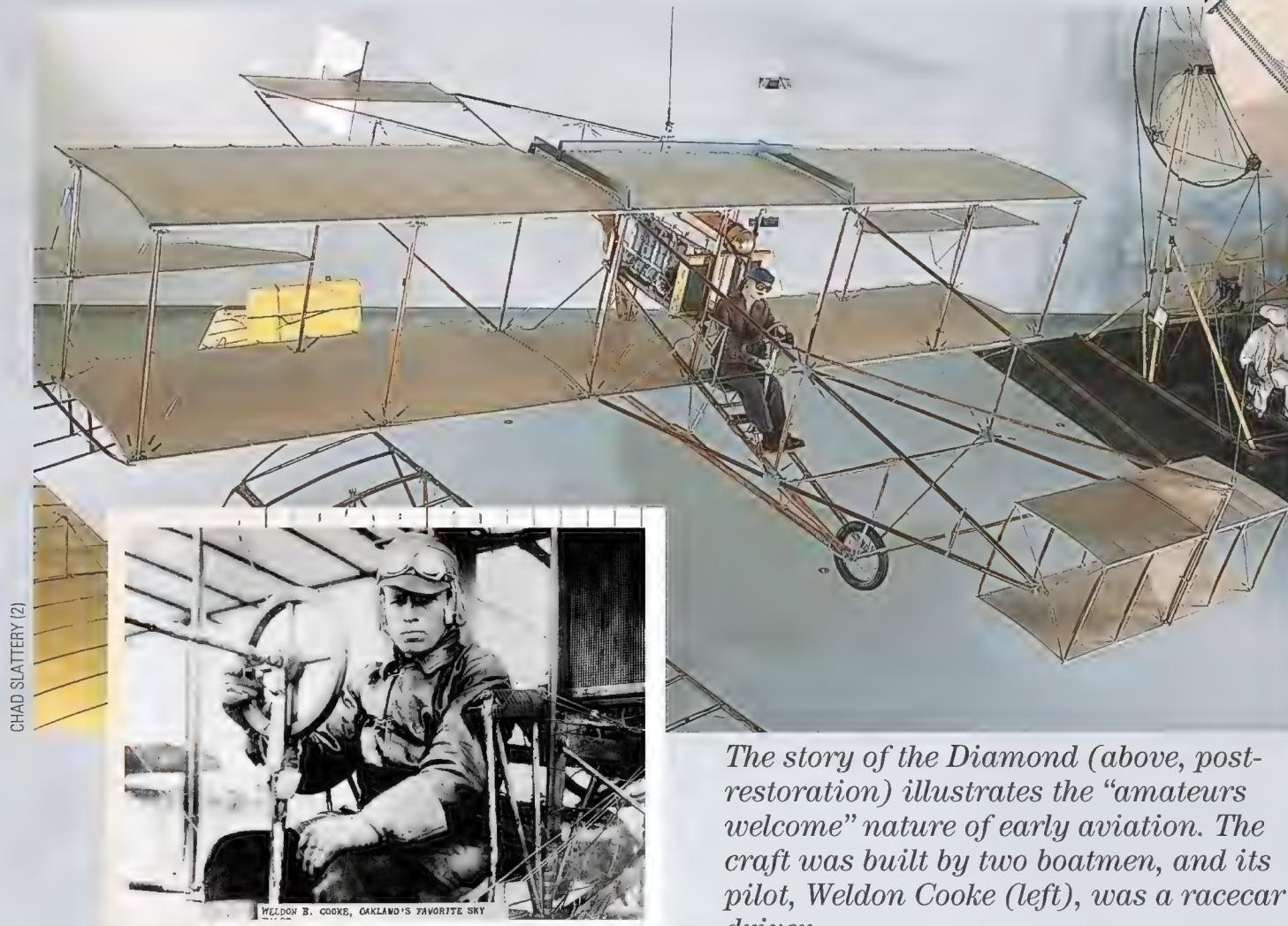
development," he says. "Danbury glass, Kodak glass, and Ball beryllium. The prime [contractor] and NASA may jointly make the selection, or they may carry two designs for a while as a backup. This is new technology no one has ever tried before."

But in this field, today's innovations quickly become tomorrow's antiques. Even after the NGST is boosted to its lonely post at Lagrange point 2, both glass and beryllium may be passé. Seery and other NASA officials hope to start a program—the Large Telescope Systems Initiative—that would start looking at other lightweight materials for mirrors. But for now, either glass or beryllium, in a six- or seven-meter mirror, built either by old hands at mirror making or by a team new to the game, will offer scientists their farthest look yet back in time. 



*Almost nothing is known about the period between the Big Bang and the formation of the early universe. This Hubble image shows early galaxies, but the NGST will reveal the earlier "cosmic dark ages," says NASA astrophysicist John Mather.*

# Resto Unearthing a Diamond



CHAD SLATTERY (2)

COURTESY HILLER AVIATION MUSEUM

For just under \$40,000, an aspiring aircraft builder can order a Lancair ES kit from Lancair International in Redmond, Oregon. Or, he could just grab a pen and a notebook, head down to the local fly-in, draw a picture of a Lancair, and then go home and build one.

Kit builders today, who sink infinite hours into complex construction plans, would scoff at the idea. But around 1910, a dredge captain and a shipyard operator in Pittsburg, California, did exactly that—or so the legend goes. Lan Maupin and Bernard Lanteri were said to have copied the details of their

aircraft, the Diamond, from a Curtiss biplane they saw at an exhibition.

But according to Newton Craven of the Hiller Aviation Museum in San Carlos, California, which recently restored the craft, it's more likely that the two men based their plans on magazine articles published in 1910 and 1911 that gave the specifications for a Curtiss-type biplane.

To fly their craft, Maupin and Lanteri hired Weldon Cooke, a racecar driver who wanted an entrée into the glamorous world of aviation. Over the next four months, Cooke learned enough aeronautics to get his charge airborne;



The Diamond's decrepit state called for innovations. The restorers fashioned new turnbuckles from stovebolts they bought at a hardware store.

*The story of the Diamond (above, post-restoration) illustrates the "amateurs welcome" nature of early aviation. The craft was built by two boatmen, and its pilot, Weldon Cooke (left), was a racecar driver.*

during his early flights, he survived a dunk in Lake Merritt and circled Mount Tamalpias at 3,000 feet.

In January 1912, the trio entered the Diamond in the Dominguez Hills Air Meet. Cooke set two records: for duration, with a total time airborne of over 18 hours, 22 minutes, and for altitude—5,800 feet. The team won \$7,400, but for some reason lost to history, the Diamond was never flown again.

In 1933, the Oakland Port Authority gained possession of the Diamond and put it on display at the Oakland airport. Fifteen years later, it was acquired by the Smithsonian's National

# restoration



CHAD SLATTERY

Hiller restorer Newton Craven installs the re-created ash laminate propeller.

*Even though the Diamond flew decently enough (bottom), even winning prizes for its performance, its owners retired it after just a few months.*

*After 86 years of storage and outdoor display, the Diamond's fabric was too tattered to restore (below). The Hiller staff used new lacquer-coated Irish linen.*

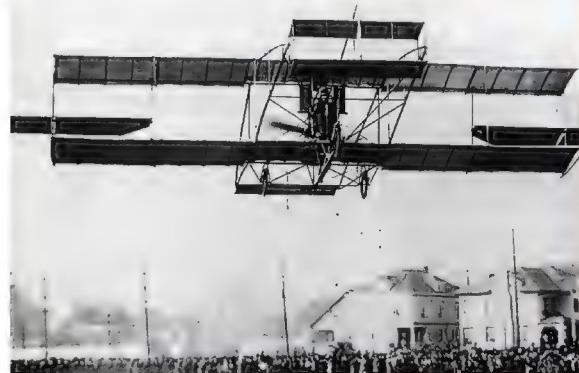


COURTESY HILLER AVIATION MUSEUM (2)

Air Museum, which put it in storage. In 1998, the Hiller museum, which focuses on Northern California's aviation history, became interested in the Diamond and made some inquiries. The National Air and Space Museum agreed to send it to Hiller for restoration and display.

The years in limbo had taken their toll on the Diamond. When it arrived at Hiller, pieces were weathered and unlabeled, and others weren't even there.

The missing-parts dilemma was unexpectedly solved when Craven, one of the Diamond's restorerers, was flipping



old periodicals. "I just happened to spot this picture of Paul Poberezny [the founder of the Experimental Aircraft Association] with the Diamond's control column," he says. Apparently, in 1964 Poberezny had acquired some of the Diamond's parts from a friend, who in turn had inherited them as part of the inventory of the California Aeroplane Company (how that company got them is unknown).

Soon afterward, the parts—the undercarriage and wheels, aileron sys-

tem, bamboo control rod, and wing compression ribs—were reunited with the rest of the Diamond. Referring to old drawings, photographs, and articles, the restoration team set to work.

The completed Diamond went on display at Hiller last February. It is really no more remarkable looking than an ordinary Curtiss of the same period, but its history gives it its distinction. Whether originally constructed from memory or assembled from diagrams, the Diamond is essentially the first homebuilt aircraft. And that is remarkable enough.

—Becki Bell

# JUNKERS JU 52

## WORLD WAR II AIRCRAFT THAT WERE SHOT TO HELL— AND CAME BACK.

by Cory Graff

**I**HIS fellow pilots see a fire raging beneath the cowling and a propeller windmilling out of control. They catch a final glimpse of his craft in a slow turn toward friendly territory, spewing oil and black smoke as enemy fighters move in for the kill. After they return home, the airmen are sadly contemplating their fallen comrade's fate when a commotion brings them outside. A sputtering machine appears, flares at the last possible second, and disappears into a cloud of dust and debris. A shaken young man emerges. He tells his story as the others hurriedly round up his belongings, which have already been divvied up among the other flyers.

From such stories, certain airplanes earned a reputation for the ability to bring their crews home during World War II. The tales were swapped, enlarged, and argued over as pilots and crew swore allegiance to their ships, convinced that they owed their survival to the designers at Boeing, Lockheed, Douglas, Grumman, or Martin. But was one airplane really more indestructible than another?

Exaggeration has played a part in inflating the reputations of certain aircraft, says Dik Dazo, a former Air Force fighter pilot and now curator of modern military aircraft at the National Air and Space Museum, but, he adds, "some aircraft did handle battle damage better than others, and that is still true today."

For instance, there is evidence to suggest that the aircraft often mentioned as the most rugged of World War II—the B-17—was, in fact, stouter than its stablemate, the Consolidated B-24 Liberator. "The B-17 had a huge wing," says archivist Dan Hagedorn of the National Air and Space Museum. "You could put a lot of holes in it and it'll keep on going." Hagedorn says the B-24's thin,





NATIONAL ARCHIVES/USAF COLLECTION (2)



high-aspect Davis wing, which had low drag characteristics at a low angle of attack, gave the Liberator a bomb load, range, and cruising speed superior to those of the B-17. But the airfoil's performance was quickly degraded by flak or cannon fire from attacking German fighters.

In some cases, says Hagedorn, it was the conditions under which an aircraft type was flown that contributed to perceptions of great durability. The B-24s that attacked the refineries at Ploesti, Romania, experienced some of



*Back home and thankful: The crew of a B-17 Flying Fortress surveys the damage (left). An 88-mm flak shell left Larry DeLancey's Fortress faceless but flyable.*



NATIONAL ARCHIVES/USAF COLLECTION

Ground crew found only "a few longitudinals and 27 inches of skin" holding together Sweet Pea, a B-17 hit by flak on a raid over Debreczen, Hungary. With the rudder and elevator cables severed, pilots Guy Miller and Thomas Rybovich maneuvered the aircraft with the engines and brought it back to Foggia, Italy.

THE SQUADRON HISTORIAN LATER REPORTED THE HOLE IN THE BOMBER WAS "LARGE ENOUGH FOR A JEEP TO PASS THROUGH."

the worst flak in World War II. But, in general, he says, the flak that the B-24s of the 15th Air Force experienced as they flew over Italy and Rome was "intense, but not as intense as that over Munich or Berlin," where more B-17s than B-24s were found.

In fact, despite the latter aircraft's impressive moniker, the Luftwaffe proved that there was no such thing as a flying fortress. The B-17 suffered some of the most appalling losses of any type during the war—more than 40 percent of the aircraft that rolled off the assembly lines were downed over Europe. And yet its legend grows.

Not every type of aircraft was known to be particularly rugged, nor did every pilot get a reputation as the ace of the base. But under the right combination of pilotage and providence, any aviator, and any aircraft, could return home and become a legend.

### Fortresses

The B-17 was the Army Air Forces' relative oldtimer, first flying in 1935 as Boeing's Model 299. The last production version, the G, carried 13 .50-caliber machine guns and had a crew of 10. It formed the backbone of Curtis LeMay's daytime strategic bombing campaign against the Reich.

Over North Africa, a Bf 109 collided with a B-17F named *All American*. The fighter tore through the rear fuselage of the bomber and tumbled to Earth ensnared in the wreckage of the B-17's left horizontal stabilizer. Crewmen in nearby aircraft were shocked to see *All American* pitch up, recover, and miraculously fly on. Lieutenant Charles Cutforth, in the *Flying Flint Gun*, snapped an image of the stricken bomber that would become famous: *All American* cruising over the desert landscape, with a ragged slice through its fuselage.

Yet another famous World War II image shows a B-17G shot through the chin with an 88-mm anti-aircraft shell over Cologne, Germany, in 1944. As Lieutenant Larry DeLancey recalled in the U.S. Army Air Forces' *Impact* magazine, "What little there was left in front of me looked like a scrap heap." The dangling nose guns chattered against the in-



BOEING COMPANY ARCHIVES

The B-17 All American lost a stabilizer and was slashed by an out-of-control Bf 109 with a dead pilot aboard.

board propellers, the oxygen system failed, and all the instrument indicators sank to zero. Yet DeLancey found all four engines roaring away and the airplane controllable. Why not try for home? As cold air hammered in, the B-17 dropped out of formation and turned toward England. Hours later, men at the Nuthampstead airfield heard the awful howling of the injured Fortress before they saw it appear over the field and deliver its crew.

On a bombing mission over the rail yards in Debreczen, Hungary, another anti-aircraft shell found its mark in the waist compartment of a B-17G named *Sweet Pea*. 429th Bombardment Squadron historian Allen Ostrom later reported in the unit's official history that the hole in the bomber was "[l]arge enough for a jeep to pass through" and added, "Observers who had seen the plane hit had given all hope up of it returning to base." With every tail control cable but one lost in the shattered mess of the fuselage, the pilots held the bomber on course by manipulating the throttles. Hundreds of miles later, *Sweet Pea* made a crash landing at its base in Foggia, Italy. Boeing sources reported the airplane was held together "by a few longitudinals and 27 inches of skin."

The B-17's big brother proved to be no less rugged. On a bombing mission near Tokyo, Japan, a Boeing B-29 Superfortress named *Irish Lassie* was rammed twice by Japanese aircraft and then riddled with gunfire when it fell out of formation. At the same time, a B-29 named *Pride of the Yankees* suffered damage that left its two left engines dead. The chances of either airplane returning across at least 1,500 miles of lonely ocean to the island of Saipan were very slim, yet both beat the odds. *Irish Lassie* flew home and broke apart upon landing when its nose gear collapsed. However, the entire crew survived.

*Pride* would be repaired to fly again. On a mis-

WITH EVERY TAIL CONTROL CABLE BUT ONE LOST IN THE SHATTERED MESS OF THE FUSELAGE, THE PILOTS HELD THE BOMBER ON COURSE BY MANIPULATING THE THROTTLES.



NATIONAL ARCHIVES/USAF COLLECTION

German pilots knew the B-17F was vulnerable to a head-on attack. The later G model was given a chin turret.

sion over Japan four months later, it again suffered damage that destroyed its two left engines. And again, it returned to Saipan.

### The Lightning

Lockheed P-38 pilots often noted that the Lightning had two Allison engines so that when one failed—they claimed one always did—the pilot could make it home on the other. The P-38's engine problems were an annoyance, but in combat, when the two V-12 powerplants were running smoothly, redundancy could prove critical to getting back to base.

Over North Africa, P-38 pilot Lieutenant Benton Miller was so fixated on strafing ground targets that he didn't see a telephone pole. The ensuing collision tore away one propeller and cleanly snapped the pole in half as it crashed through the fighter's wing. Miller's craft had a dead engine, the left wing was twisted upward and backward, and a crushed gun bay access door scooped air like a speed brake. Amazingly, the pilot coaxed the battered Lightning back to friendly territory and made a safe landing.

As the late aviation writer Martin Caidin recounted in *Fork-Tailed Devil: The P-38*, not even a mid-air collision could always stop a Lightning. Lieutenant Thomas Smith's P-38 smashed headlong into a disintegrating Bf 109 as the German fighter's spin-

*With its rudders deflected to steer a straight course, Fred Erbele's P-38 heads for home near Iwo Jima on a single Allison V-12 after the Lightning was holed by ground fire.*



NATIONAL ARCHIVES/USAF COLLECTION

*The B-29 Superfortress Irish Lassie was riddled with gunfire and rammed twice by Japanese fighters during a mission over Tokyo. The bomber flew home to Saipan, where it slammed into the runway and skidded to a stop after its nose gear collapsed. The entire crew survived.*





NATIONAL MUSEUM OF NAVAL AVIATION

*After tangling with Japanese fighters near New Georgia in the Pacific, Marine pilot Donald Balch of VMF-221 contemplates the wounded tail feathers of his Corsair.*

**AS THE CORSAIR'S ENGINE COUGHED AND PROTESTED, KLINGMAN ALMOST GAVE UP HOPE OF GETTING BACK TO OKINAWA—NEARLY 150 MILES AWAY.**

ning propeller tore gashes in the P-38 from engine to tail and severed the horizontal stabilizer, which extended between the Lockheed's twin booms. Worst of all, the P-38's right engine froze with the prop blades at a high-rpm setting, so they were set almost flat to the airstream.

Smith radioed that he was bailing out and jettisoned his canopy—an action he would regret in the cold hours that followed. As soon

as he let go of the control yoke and took his feet from the left rudder pedal, the P-38 rolled violently into the dead engine. It would be nearly impossible for the aircraft to stay stable long enough for Smith to jump.

Smith made it back by flying a series of climbing orbits followed by a short dash toward home base. When he stumbled over the enemy-occupied town of Trieste, Italy, every flak burst sounded horrifyingly close as he flew with no canopy. Incredibly, Smith made a wheels-up landing. Besides being exhausted and half-frozen, he suffered his only injury upon landing—a lump on his head from hitting the gunsight.

#### Corsair and Hellcat

Flying and fighting over the vast Pacific Ocean, a Navy or Marine Corps pilot with a crippled aircraft usually had only two options—bail out into the sea or limp back to shore or to the carrier. Built to survive the controlled violence of repeated carrier arrested landings, many Naval aircraft could withstand extensive battle damage with the brawn of a battleship.

One Vought F4U Corsair chased down a Japanese "Nick" fighter near Okinawa. At a range of 50 feet, Marine Lieutenant Robert Klingman found his guns frozen by the cold at 38,000 feet. Unwilling to let his quarry go, Klingman pushed on, ramming the aircraft's tail and rear cockpit and downing the Nick. The Corsair's engine coughed and protested, and it seemed unlikely Klingman could coax his airplane back to Okinawa—150 miles away—but the engine continued to run until the fighter was within gliding distance of the island's runway.

But perhaps the king of the rock-solid World War II Navy fighters was Grumman's F6F Hellcat. If it can be said that the Japanese designed the Zero to reflect the best characteristics of a samurai warrior—swift, nimble, and lethal—then the Long Island-based Grumman Aircraft Engineering Corporation built the Hellcat to emulate a burly Brooklyn bouncer.



GRUMMAN CORP.

Grumman's "Iron Works" produced a long line of fighters for the U.S. Navy, but none was more legendary than the F6F Hellcat. Some came back to the boat so shot up the deck crew had no choice but to push them overboard.

Built around the powerful and reliable Pratt & Whitney R-2800 radial engine, the Hellcat began as a concept for an improved F4F Wildcat, but what emerged was a fighter that shared little with its predecessor except ruggedness. Unlike its Japanese counterparts, the Hellcat's vital areas, such as the cockpit and engine oil tank, were protected by thick armor plate.

When a new facility was needed to build Hellcats at Grumman's Bethpage plant, some of the steel for the project came from the remains of New York's old Second Avenue elevated railway. As tough as the aircraft were, the recycled steel inspired an oft-repeated joke that became part of Hellcat lore. As the new fighters thumped down on carrier decks around the fleet, crewmen would say, "Here comes another piece of the Second Avenue El!"

The stories of the Hellcat's ruggedness perhaps started with Lieutenant Casey Childers, whose F6F experienced engine problems during a delivery flight. Descending toward a forest 30 miles north of Cape May, New Jersey, Childers dead-sticked his aircraft through the trees, and when the remains of his Hellcat stopped cutting wood, he emerged from the cockpit uninjured.

In the Pacific, the Hellcat's legend continued to grow. While Lieutenant Bruce Williams was strafing an ammunition barge, his Hellcat was blown upward 250 feet and showered with debris. The shredded fighter came back to the carrier with stove bolts and pieces of planking embedded in its wings and underbelly. After the deck crew examined the damage and determined the Hellcat was beyond repair, it was pushed overboard.

### The Thunderbolt

While often used as a high-altitude bomber escort, the Republic P-47 also showed amazing ability as an attack aircraft—going down on the deck to hunt down and ruthlessly blast trucks, tanks, and trains. The Thunderbolt's sawed-off snout and heavy, all-business airframe caused some P-47 flyers to give it a name that stuck: the Jug.

In the Pacific, a flier describes how a fellow P-47 pilot hauled his Jug into a tight turn to get a shot at some

*"What do I tell the CO?" Low flying P-47 Thunderbolt pilots sometimes trimmed trees while strafing.*



NATIONAL ARCHIVES/USAF COLLECTION (3)

THE BIG FIGHTER SLID INTO THE TREES, BRIEFLY DISAPPEARED FROM SIGHT, AND THEN EMERGED, SEEMINGLY NO WORSE FOR WEAR.

Japanese trucks. The big fighter slid into the trees, briefly disappeared from sight, and then emerged, seemingly no worse for wear. Coming home, the pilot noticed his engine was running hot; once he was on the ground, everyone gathered around to find the engine cowl stuffed with branches as thick as a man's wrist.

Famed ace Robert Johnson was tumbled out of his squadron's formation by Luftwaffe Focke Wulf Fw 190s that left his Thunderbolt riddled with holes and his canopy jammed closed. Nearly blinded by leaking hydraulic fluid, Johnson was coaxing his crippled airplane toward England when another Fw 190 caught up with him. As Johnson hunkered down behind his armor plate, the German pounded his P-47 with machine gun fire. Between barrages, the enemy fighter cruised alongside, as if its pilot was puzzled by the invulnerability of the Jug, which, hit with dozens of rounds, refused to go down. With his ammunition expended, the pilot finally climbed away.

So could you really, as some pilots claimed, fly a P-47 through a brick wall and live? A post-war Air National Guard Thunderbolt undershot the runway upon landing and plowed into the second story of a factory. With its wings sheared off, the crumpled fuselage came to rest inside the building. The pilot walked away. —



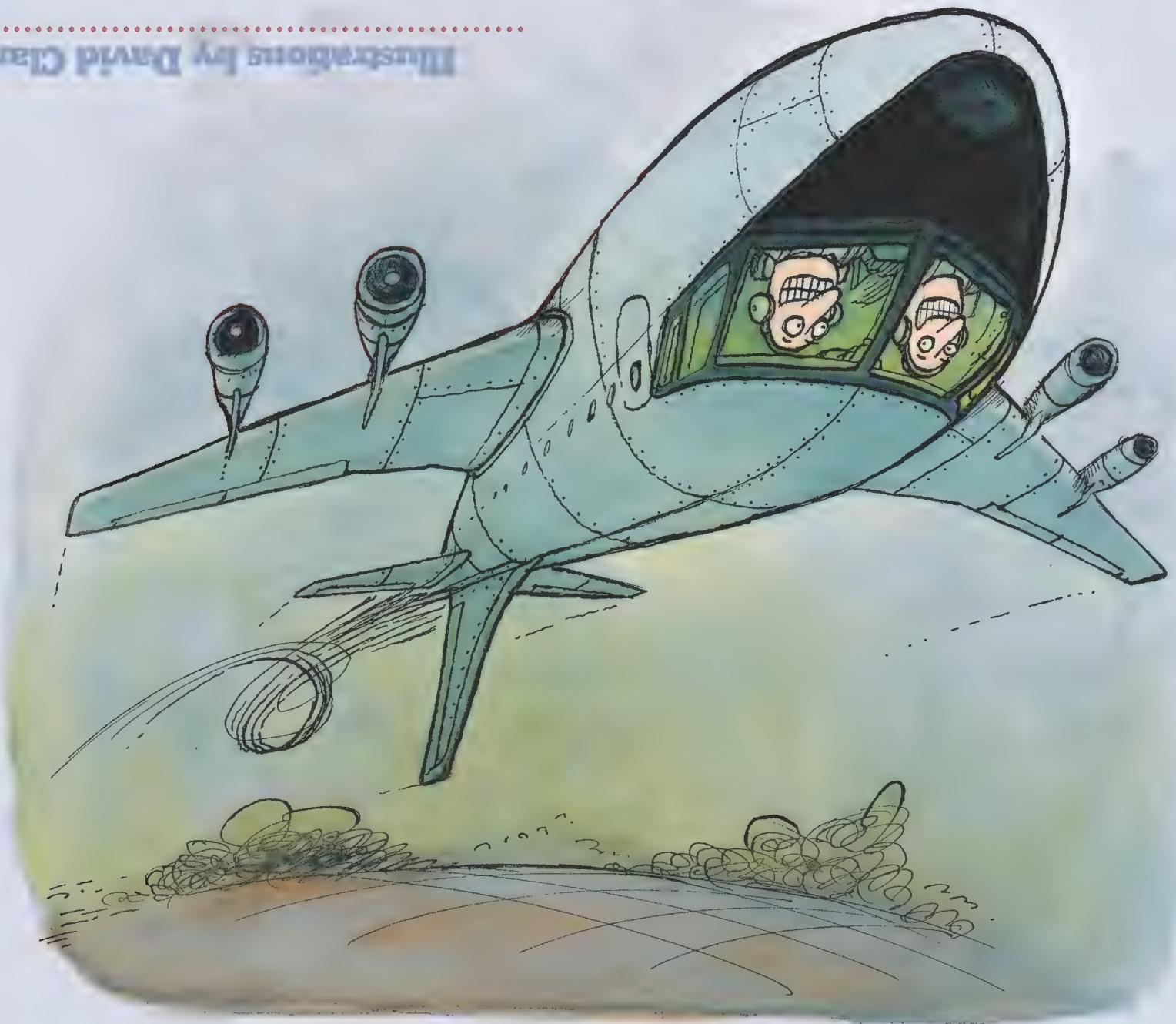
A pilot looks over his perforated Jug (above). The R-2800 engine in Edwin King's Thunderbolt stayed with him even after the oil didn't (below).



# Stupid Plane Tricks

by Phil Scott

Illustrations by David Clark



Breathes  
there the  
pilot with  
soul so  
dead who  
never to  
himself  
hath said,  
“I bet I  
can fly  
under that  
bridge”?



### Michael Zang is the kind of guy people call crazy.

One reporter called him “the nuttiest guy this side of the stratosphere.” Leaping out of an airplane for 24 hours straight last May, Zang shattered the old world record of 476 skydives in 24 hours, set by one Jay Stokes in 1999. Zang jumped 500 times from an altitude of 2,100 feet, once every 2 minutes and 40 seconds—despite banging up his knee on jump 438. His pilot, Tom Bishop, kept the single-engine Pilatus Porter going and going and going. And in the end, what did this Continental Airlines first officer accomplish? Zang laughs, then searches for a reasonable way to explain why someone would keep leaping out of a small airplane for 24 hours. “We raised \$15,000 for Special Olympics,” he says.

Ever since the airplane was invented, pilots have been thinking up something that no one’s done in an airplane, then doing it—or dying in the attempt. Though it’s hard to say who did the first stupid airplane trick, Lincoln Beachey gets my vote. In 1911, Beachey flew over Niagara Falls and under the nearby International Bridge before a crowd of 150,000. He had been taught to fly by Glenn Curtiss just six months earlier. Beachey drowned in San Francisco Bay in 1915 after a wing snapped off his monoplane, *Little Looper*, while he was performing its namesake maneuver.

In 1942, future World War II American ace Richard Bong looped San Francisco’s Golden Gate Bridge in his Lockheed P-38 Lightning. “It’s not very congested and has a clean approach from both sides,” says Mike Pablo of the National Aeronautic Association’s contest and records department. “The Golden Gate Bridge would be an enticing thing to fly underneath.”

In May 1942, a flock of employees of the Dutch airline KLM flew under Australia’s Sydney Harbour Bridge—twice. Nicholas Dijkstra, a KLM navigator, reports that people from KLM were stranded in Australia with five transports—DC-3s, -5s, Lockheed Electras—which they decided to hand over to U.S. forces based in Wagga Wagga. Two Curtiss P-40 Kittyhawks had recently flown under the bridge, to the extreme excitement of Sydneysiders, and the Dutch fliers figured they could create an even bigger stir by flying under the bridge in formation. Nearly 50 people volunteered for the mission and appointed radio operator Joe Muller to get permission from the tower at Kingsford Smith Airport. He came back down and gave a big thumbs up, and the flight launched. The pilots flew under the bridge in formation, made a wide turn, and flew under it again in single file. Then they returned to the airport. All hell broke loose—it turned out that Muller hadn’t asked permission at all, and the ramp fairly erupted with

authority figures. The nation had no flying regulations in place at that time, but the authorities instantly declared that future bridge transgressors would be fined \$200—for each person on board.

Even the normally cautious Jimmy Doolittle got into flying stunts. In 1927, U.S. Army Air Corps pilot Doolittle pioneered a maneuver he called the “outside loop” at Ohio’s Wright Field, “on the spur of the moment,” he told reporters, though in reality he spent a lot of time planning the maneuver. Doolittle dove a Curtiss P-1B Hawk from an altitude of 10,000 feet until he reached nearly 300 mph. He bottomed out upside down, pushed the stick forward, and climbed to finish the loop.

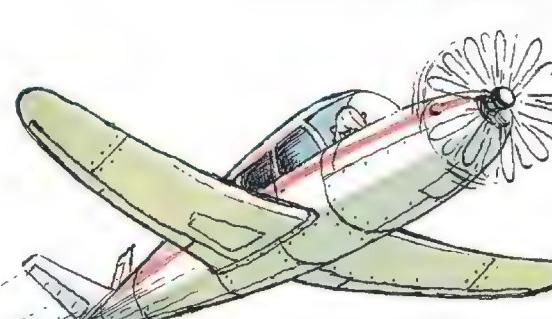
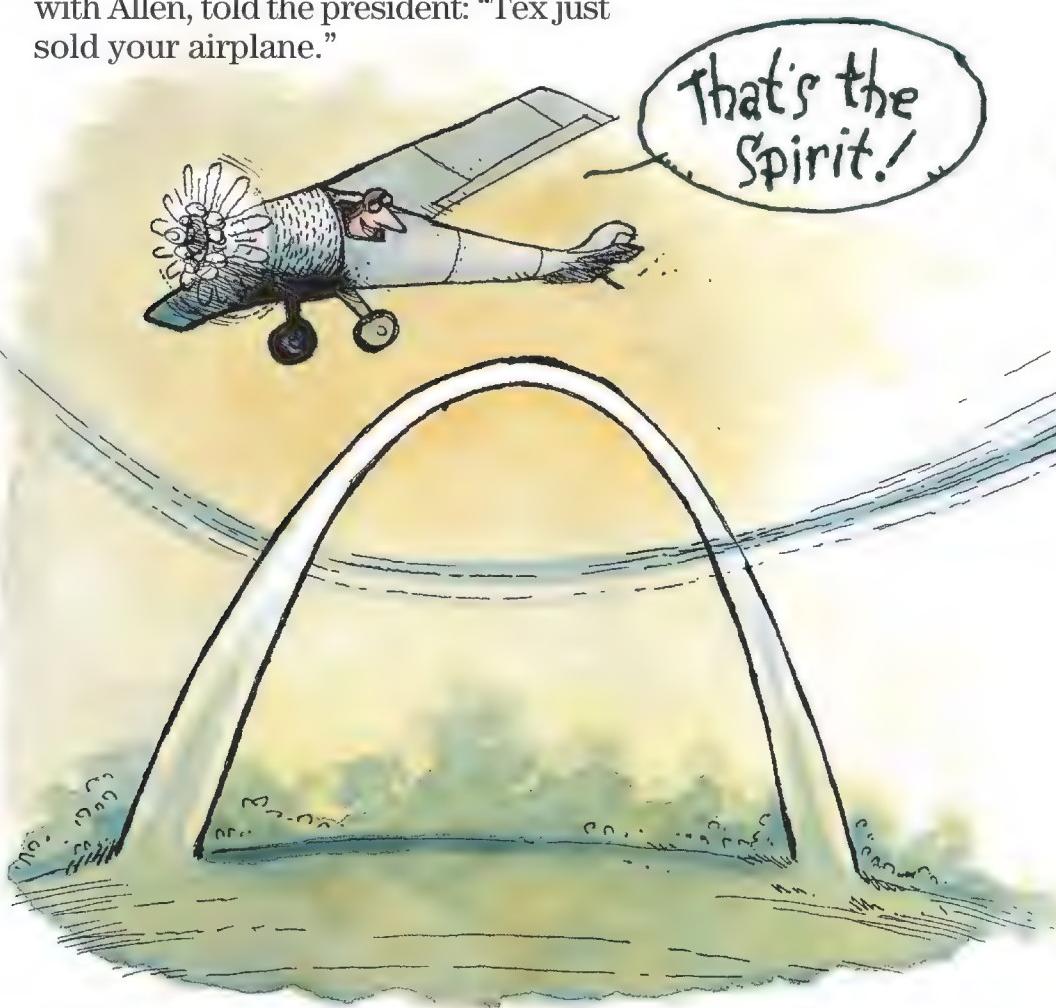
Everyone’s heard the tale about test pilot “Tex” Johnston, who, flying Dash 80, the Boeing 707 prototype, before an audience of 200,000 at Seattle’s annual Seafair festival on August 7, 1955, rolled the big beast. Twice. Johnston test-rolled the airplane on the way to the flyover, and he determined that the maneuver, properly executed, exerted a mere one G on the airframe, the same as level flight. The next day he got a strong talking-to from Boeing president William Allen, but he also learned that Larry Bell, the chief of Bell Aircraft, who watched the whole thing with Allen, told the president: “Tex just sold your airplane.”

Ever since the airplane was invented, pilots have been thinking up something that no one has done in an airplane, then doing it—or dying in the attempt. In an effort to thwart such antics, the Federal Aviation Administration forbids flying less than 2,000 feet above most structures, and also forbids flying in a “careless or reckless manner,” lest the offender’s pilot’s license be revoked.



Ever since the Gateway Arch went up in St. Louis in 1965, pilots have eyed it longingly. Balloonist Nikki Caplan’s 1973 flight was the first time an aircraft breached the sanctity of the arch with permission, but in fact five airplanes are known to have flown through it, though none of them was ever identified—or prosecuted by the Federal Aviation Administration, which forbids flying less than 2,000 feet above such a structure, and also forbids flying in a “careless or reckless manner,” lest the offender’s pilot’s license be revoked. “We haven’t had a fixed-wing aircraft do it since the ’70s,” says National Park Service historian Bob Moore. “It’s kind of a sensitive subject—the less we publicize it, the less people will do it.”

French officials feel the same way. Consider the stunt Robert Moriarty pulled off in 1984 in a Beechcraft V-tail Bonanza. On the morning of Saturday, March 31, he filed a plan to fly to Shannon, Ireland, took off from Paris’ Le Bourget airport, and headed for the north of Paris, where local air traffic control released him. Then he headed straight for the Eiffel Tower. Flying low and slow, he lined up to the south of the tower along a two-mile-long garden, aimed for the arch, then flew through with plenty of room to spare. Moriarty had a cameraman along, who





got the whole thing on videotape (see [www.airspacemag.com](http://www.airspacemag.com)), and he dropped the guy off at a small field outside of Paris. Then he flew to Shannon and on to the United States.

Moriarty says the French were eminently reasonable about the whole thing. "If I had landed in Paris and said 'Hey, look at me—aren't I cool?' I would have had some difficulty departing the country. As it was, we reached an agreement that as long as I stayed out of France for a few years no one would give me grief.

"Somebody did it again about three years ago," he adds. "The French contacted me and said, 'Was it you?' I told them, 'Why would I do it twice?'"

Why indeed? Ask airshow pilot Wayne Handley. Back in 1989 at an airshow at Salinas, California, Handley strapped on a Pitts Special, climbed to 12,000 feet, flipped it over, and kicked it into a flat spin. Sixty-seven turns later he got right side up and claimed the world record for consecutive inverted flat spins. "I did it for two very good reasons," Handley says. "First, as an airshow performer, it was good publicity. And the second, which kind of also had an advertising side of it: It was my trademark." Not long after, the NAA decided stunts like that were too dangerous and stopped handing out records for such feats. "I don't disagree,"

Handley says. "An inverted flat spin is kind of raising the bar on craziness." But in April 1999, Guinness World Records asked him to do it again for its TV show. "They [Guinness] will accept anything for a record: How many elephants can you pull with your earlobe—you know." This time, for the cameras, he climbed to 16,000 feet and flew 78 turns, pulling out after two minutes at 2,000 feet. Seven months later, after a crash landing broke his back, he retired from the airshow circuit and left aerobatics to the young Turks.

Others in the airshow world have made names for themselves not by the maneuvers they perform but by the stunts they pull. Take Jon Falkner and Bob Essel, who do a wingwalking routine on a Quicksilver ultralight—with no restraints. "I never said I was smart," says Falkner. They got started 11 years ago after watching a wingwalker at the annual Experimental Aircraft Association fly-in at Oshkosh, Wisconsin. "We became the only professional ultralight wingwalkers in the world," he says. "It's a lot of fun when things are going well." And if they're not? "We don't go there," he says. So far, he and "Always Steady Bob" have an accident-free record. "I can stand on the front with no belts, no harnesses, no goggles, and fly with my body," Falkner says. "It's a real hoot." Why no restraints? "I used them for a while but I got tired of getting caught and tangled up in these things early on, getting them wrapped around my neck and legs, and when you unhook them and hook them again you have to take

your hands off the airplane and they give you the chance to be not quite so cautious." A few of the other dozen or so wingwalking acts have also shed their restraints.

The apocryphal story about low-flying jet jocks trying to set off a record number of car alarms in the parking lot "is a common one at any Air Force or Navy base where pilots fly high-performance aircraft, and it circulates around here as well," says Edwards Air Force Base spokesman Alan Brown. But, he adds, "If any of our pilots intentionally tried to do that, and it could be substantiated, they would be looking for a new job immediately.

"What does happen is that every time we have a sonic boom occur out here—usually from an Air Force jet jock way up high—a bunch of car alarms will go off as the shock wave passes. Also—very rarely—if a loud aircraft makes a low pass near a parking area, some car alarms may sound off due to noise-related vibration." Well, I'm glad we cleared that up.

But Dick Knapinski, public relations director for the EAA, thinks the glory days of stupid plane tricks are history. "I get a feeling the populace doesn't look as kindly on stunt flying as they did 70 years ago, when it was new and wonderful," he says. "Today with the general citizenry they call to say

"There's a noisy airplane over my house—make it stop!" You get that kind of thing spraying for gypsy moths." —





**THE PEOPLE'S  
LIBERATION** **bizjet**

IN CHINA, ANOTHER REVOLUTION IS ABOUT TO BEGIN.

大元

***There's something unsettling about sitting in a \$9 million private business jet in the People's Republic of China, taking in the soft scent of leather and enjoying the plush carpeting and burled wood, while outside on the ramp a young officer of the People's Liberation Army is staring at the aircraft with a look on his face that seems to alternate between awe and disdain. The jet, a newly minted Cessna Citation Excel, is Chinese owned and registered, one of only two private bizjets in a country where per capita income is \$780 a year and general aviation, as we in the West know it, does not exist.***

Chinese television reporters are lining up this November afternoon to get a peek inside while the Excel is on display at China Airshow 2000, taking place at the Zhu Hai city airport, on China's southern coast. (Sukhoi fighters are flying aerobatics over the runway. The reporters will queue up later for them; the private jet is the real news.) A crowd has gathered just outside the cordon surrounding the jet, an all-white beauty painted along the fuselage with festive ribbons of red, blue, and green, above which is written, in both Mandarin and English, "Broad Air Conditioning," the name of the Chinese company that owns the jet. But Broad Air Conditioning's jet isn't on view for long. Less than 24 hours after arriving at the airshow, which will continue for three days, the crew is preparing to leave. The reporters get out as the PLA officer disperses the crowd and the cordon is removed.

"Chocks pulled?"

That's Rod Davis, the burly American pilot who ferried the Excel from the Cessna factory in Wichita, Kansas,

*A pilot employed by Broad Air Conditioning signals number-one-engine start (opposite). The company's jet may signal the start of a trend making the bizjet trade as busy as a Shanghai street (right).*

by William Triplett | Photographs by Tim Wright



# 公司總部



**Rickshaw operators, Suzhou.**

Cultural and economic changes begun by Mao's successor 25 years ago accelerated in the last decade, and a new class of entrepreneurs began acquiring facilities previously owned by the state.

and who's back in the cockpit, ready to go. He's president of Pilot International, Inc., an aircraft delivery service, and he's got a job to finish—flying the Excel to Changsha, its new home, some 550 miles southwest of Shanghai. Zhang Yue and his brother Jian, CEO and president, respectively, of Broad Air Conditioning, were happy to let their new acquisition make an appearance at the airshow before coming to company headquarters in Changsha, where a young Mao Zedong once worked as a headmaster. Now they'd like to take possession.

A little commotion ensues among the four Broad employees who are on board. Their English isn't very good, their knowledge of aviation jargon worse. (They're part of Broad's marketing division, and the company's clients are almost exclusively Chinese businessmen.) But they're extremely attentive and helpful, not to mention dressed in smart blue suits, and one of them not only deduces what chocks are but also finds them, already pulled and stowed in the back of the aircraft.

"That's all I wanted to know," Davis

says. The door closes; everyone straps into the cabin seats (six seats total, plus a spiffy bench for two behind the forward bulkhead). In moments the Excel is taxiing past big Ilyushin transports, a whale of an Antonov cargo aircraft, various pieces of military hardware, and throngs of people. Takeoff is a smooth affair, Davis switching his focus back and forth from the controls to the Chinese copilot, who's perusing Cessna manuals. Davis levels off at 20,000 feet—not his desired altitude. "We burn a lot more fuel down here," he says, "but air traffic control..." He shakes his head. In the cabin, one of the company employees, a woman maybe in her 20s, passes out bags of Rold Gold pretzels and bottles of Evian water.

## Cool Dudes

Broad Air Conditioning opened for business in 1988, when younger brother Jian, an engineer, developed (and later patented) an industrial-use air conditioning system. His timing couldn't have been much better. It had been 10 years since Mao's successor, Deng Xi-

*Broad CEO Zhang Yue flies in his company's Bell 427 helicopter to a local airport, where he'll catch a flight on one of China's 26 airlines.*





Broad employees prepare the Cessna Citation Excel for passengers at Huang Hua International Airport in Changsha.

aoping, recognizing that China's socialist economy had stagnated, had begun steering the country toward a market economy. Deng relaxed laws against accumulating personal wealth, billboards sprang up proclaiming "It is glorious to be rich," and slowly the communist government adopted new regulations, establishing property rights and corporate codes.

The cultural and economic changes begun 25 years ago accelerated in the last decade, and a new class of entrepreneurs began acquiring and renovating facilities previously owned by the state. In fact, Chinese government figures show that over the last five years the state has trimmed employment rolls by almost 25 percent—typically by selling a state-owned facility to the worker who had been managing it. Most of the buildings needed modernizing; few were air-conditioned. The Zhang brothers were ready to air-condition them.

Broad quickly established itself as the country's leading supplier of industrial AC. (The company now claims 3,000 clients, or roughly 80 percent of the Chinese market.) But China's sheer size—at 3.7 million square miles, about the same size as the United States—and the fact that many more potential clients were located in remote locations posed a challenge to the Zhangs'

expansion. Since the bosses themselves—the people who could say yes to buying an air conditioning unit—were too busy running their own businesses, they often sent assistants on the laborious journey to Changsha to scout out the product and report back. Working against the Zhangs were time, distance, and a certain lack of purchasing authority.

"In China there are not very many airline flights to some of the smaller cities," says Yue. So the brothers wanted an airplane to shrink the country and cut out the middlemen: Fly the bosses up, wow 'em with a sales pitch, fly 'em back. A pretty good idea, except that at the time, around 1996, only the Chinese military, government, and airlines were permitted to own aircraft and fly them in Chinese airspace.

### Trade Barriers

Throngs of people are milling around the roughly 90 aircraft displayed at China Airshow 2000, which spreads across the airport ramp and through three enormous warehouses, in which aerospace and aviation manufacturers from around the world are hawking their goods. China is the world's fastest growing aviation market, according to Elizabeth Keck, the U.S. Federal Aviation Administration's senior representative in Beijing. In an article she

published recently in *The China Business Review*, Keck quoted Randolph Baseler, vice president of marketing for Boeing Commercial Airplanes, predicting that over the next 20 years, China will be the largest commercial jet market outside the United States, requiring 1,780 aircraft valued at \$137 billion. That's the demand for airliners. The bizjet market will be much tougher to crack. But at China Airshow 2000 there's a sense that something is awakening—not least because of the Zhangs' jet sitting on display—and the bizjet makers too are poised to sell.

Near the center of the middle warehouse, three U.S. manufacturers of private aircraft—Gulfstream, Raytheon, and Boeing Business Jets—have glitzy pavilions close to one another. Of the three, only Raytheon has made a jet sale in China to date—three Hawker 800XPs, operated as a charter service by Hainan Airlines. Cessna is at the far end of the building and has sold nine jets in China so far. Besides the Zhangs, Cessna's clients have been the Chinese government, which uses Citations for official travel, and the airlines, which offer them for charter.

The bizjet sales reps are talking to a steady stream of Chinese entrepreneurs and government officials and taking potential buyers outside for a little show-and-tell. Raytheon has a Hawk-



Visitors to Broad's headquarters can view the pyramidal science museum and manufacturing plants from the window of a company Bell 427 (right).

er 800XP on display; Gulfstream has a GIV-SP. For the moment, Cessna is using the Zhangs' Excel.

"So much of what we're trying to do is basically just get people exposed to the product," Roger D. Sperry, Gulfstream's vice president of worldwide sales, said later. People are definitely interested, he said, "but we've known all along that you can't rush this market." After 12 years of making contacts and developing relationships in China, Sperry reports that Gulfstream is close to making sales here.

One reason it's taken so long is that identifying potential clients is a struggle: Unlike Western businesses, Chinese companies don't make public their revenues, expenditures, and activities in formats like quarterly reports that reveal who's doing the kind of business that would benefit from a private jet and who's got the money to afford one. Attending the airshows has certainly helped, but this is only the third that China has mounted. Gulfstream and other dealers have sometimes relied on items in the news for indications of likely clients.

Sales are also impeded by legal restrictions that make it difficult to buy and operate private aircraft in China. The country has no equivalent, for example, of U.S. Federal Aviation Regulation (FAR) 91, which provides basic safety standards and flight rules for individuals and corporations operating general aviation aircraft. The General Administration of Civil Aviation of Chi-

na—the CAAC—requires all aircraft to be placed "under the supervision and management of an organization, such as an airline or a flight training school that has been authorized with air traffic rights," according to an FAA report on the policy. For such organizations, regulations are already in place.

The air traffic system itself has discouraged private ownership. In the People's Republic of China, almost all airspace is owned and tightly controlled by the People's Liberation Army. Civil aircraft may fly only along dedicated routes, typically about 25 miles wide at approved altitudes. But of the 1,122 such routes, which are shared by airliners, a few charter services, foreign-owned business craft, and the military, only 29 are currently controlled by the CAAC. The rest are administered by the PLA.

According to several Westerners representing U.S. aviation interests in China, the CAAC is full of "forward-thinking people," as one sales rep puts it, who strongly support developing general aviation in China. The CAAC is slowly winning over governmental support, but the PLA is yielding airspace only gradually.

Under these circumstances, there has been little need to create procedures whereby individuals could purchase aircraft. When the Zhang brothers came to Zhu Hai for the first China Airshow, in 1996, the laws stated (as they still do) that only China's airlines, their affiliates, and the government



could buy and import aircraft. But Cessna had a Citation on display, and the Zhangs liked what they saw. The following year Yue visited the Cessna factory in Wichita. He also dropped in on the folks at Gulfstream (comparison shopping knows no borders). The Citation was cheaper, and he felt Cessna's factory was slightly better managed. He went with the Citation 525.

According to someone familiar with the transaction, the Zhangs, with help from a Hong Kong aviation company but mostly through sheer entrepreneurial will, got China Southern Airlines to act as sponsor of the 525 and essentially secured all necessary approvals after the fact. That's the kind of clout you can wield in China if, like Broad Air Conditioning, you're a fully private, debt-free, domestic company employing 1,400 people and bringing in about \$240 million a year in sales. "The Zhangs have a great deal of influence," says the source, who asked for anonymity.

What they and other Chinese citizens don't have, because of existing regulations, is the right to operate jets as private individuals. So the brothers hired two pilots and an engineer from a domestic aviation "academy," as it's called—essentially a group of airline pilots who fly charters and are overseen by the CAAC. The Zhangs' pilots wear Broad Air Conditioning uniforms, but Broad pays the academy for their services, and the academy in turn pays the pilots. "It's the politically expedient way," says Rod Davis, who also delivered the Zhangs' 525.

### Leading Edge

The Changsha airport is a modern monstrosity of concrete, glass, and cinder block, but on one of its flanks stands a relatively new, small hangar surrounded by an almost pristine ramp—the parking lot for Broad Air Conditioning's burgeoning little air force. There's another Cessna Citation—the 525, Broad's first jet, bought in 1997 and up for sale now that the Zhangs have traded up to the Excel. Three Cessna 172s are parked next to it. Old-

# 管制空域



**Police officer, Pudong Airport.**

**In the People's Republic of**

**China, almost all airspace is**

**owned and tightly controlled**

**by the People's Liberation**

**Army. Civil aircraft may fly**

**only along dedicated routes.**

er brother Yue wants to use the 172s to start a flying club. Zhang Yue, in fact, is crazy about flying. He was trained by CAAC instructors to fly the company's other aircraft—a Bell 206B helicopter—but Broad has since moved up to a twin-engine Bell 427.

"The efficiency of work has improved as a result of having the jet," says Yue. He adds that he can't put an exact figure on how much sales have increased, but the rise in revenues is the principal reason that he and his brother decided to move up to the Excel, which has a longer range than the 525. And he does venture an estimate of how much the Excel will boost sales—by \$50 million—suggesting that he and his brother have already targeted some new clients.

Changsha airport and its downtown environs recede quickly from view when you get on one of the highways that lead into the rural areas, where there seems to be an unending strip of dilapidated buildings and dusty, dent-ed cars that don't look parked so much as abandoned. Families live in these buildings, mostly low-rises resembling storage containers, and children and unleashed dogs run in and out of them. In part but maybe not entirely because of overcast autumn skies, everything has a gray pallor to it, including the grass. Turn in to Broad Town, head-

quarters of Broad Air Conditioning, and the scenery changes dramatically. The campus—verdant, elegant—stretches out almost like a golf course, and might well be one were it not for the helipad and multiple commercial buildings, constructed of pale brick and reflecting windows. Everything takes place here, from manufacturing the air conditioning units to computer-monitoring them after installation around the world. Employees live on campus in company-provided apartments. There's a cafeteria-cum-entertainment building (designed with a nautical theme) and a recently built science museum, which the Zha ng s designed in the shape of a pyramid. Under construction is Broad's own management school, which looks a little like a Beaux Arts mansion.

In a lobby on the second floor of the main building sits a large landscape model of Broad Town: The only feature not yet realized is a runway and hangar on one of the campus edges.

A long corridor leads off the lobby and down to Zhang Yue's office. The office décor is more functional than stylish: a big black desk, two big black metal cabinets behind it, and white walls. Arrayed across the top of the cabinets are models of jets, including a Citation Excel. On a Wednesday evening in November, Zhang is seated

*The interior of Pudong Airport in Shanghai exemplifies the modernization of China's aviation infrastructure.*





**Business School, Broad Town.**

The campus—verdant, elegant—stretches out almost like a golf course. Under construction is Broad's own management school, which looks like a Beaux Arts mansion.

*Teaching tool: At China's first flight school Cessna 172s are the trainers. Senior engineer Xu Pei Guang oversees their maintenance.*



at his desk, sipping green tea, smoking a cigarette, and musing about the future of general aviation in his country as young assistants periodically enter with documents for him to sign.

"China's economy is developing fast and the usage of business aircraft is developing too," he says with a grin. "But," he adds, losing the grin, "the usage is not developing as fast as we would like."

"We will be meeting with government officials about getting more airspace," he says. "But it will take a long time to change their minds." It has taken the government the better part of 20 years to get to its current point. For example, filing and receiving approval of a flight plan used to involve days. "Procedures," Yue says with a sigh. "So many of them." Now it's maybe one day's wait, he says, and less in an emergency.

For Chinese-registered general aviation craft, that is. Foreign-registered bizjets must file requests for flight plan approval at least two weeks in advance,

and if approval is granted, operators must strictly follow the original request. No deviations are allowed, not on routes, destinations, or even passenger lists. "This is a tremendous obstacle to a lot of potential foreign investors" who have bizjets, says a sales rep. "If they fly into China to visit one of their factories in Beijing, then realize they need to go to another in Shanghai, well, if it wasn't part of the original flight plan, they can't do it."

At a December 1999 meeting of the CAAC, the FAA, and other organizations working to modernize air traffic management in China, CAAC representatives announced a shift in policy. In the past, military missions had taken priority over civil aviation, so scheduled airline flights were at the mercy of the military's schedule. The new policy for coordinating the demands of military and civil aviation gives priority to civil aviation and includes a

commitment to meet "the requirements of other flight activities, such as general aviation and sport flights." One of the first steps the CAAC took toward that commitment was to make official the procedure invented by the Zhanget al. to purchase aircraft.

### Business Class?

What the manufacturers of business aircraft would like to know is: How many businessmen like the Zhanget al. are out there?

China has relatively few rich people. Most of the country's private wealth is concentrated in the eastern provinces—where the economic reforms have been most extensively implemented. According to a recently released list from the government in Beijing, there are at least two billionaires—that's in U.S. dollars—and a few dozen millionaires. There is also a small but growing middle class, and Chinese policymakers are trying to encourage that growth. "The Chinese are starting to understand that if you want to develop a big, prosperous middle class, you need lots of small- to mid-size companies," says Gwen Lyle, who works for the U.S. Department of Commerce office in China. "Those companies are the great engine of America." That's an engine China definitely wants to reverse-engineer. Such a system of production would relieve the government of the costs to employ workers and maintain infrastructure in state-run enterprises that have been losing money. What has worked in the United States, however, doesn't always transfer to China.

"This is the East," says the FAA's Elizabeth Keck. "Things are frequently the opposite of what they are in the West." For one thing, she points out, in the United States individual pilots have flown for pleasure since the airplane was invented, and U.S. regulations from the beginning were concerned with standards for the responsible use of aircraft by individuals. Aviation in China, on the other hand, grew out of a government's need to improve travel and communication across vast distances. For its entire existence, the CAAC has concentrated on developing China's airlines; its priority for aviation rules and standards has been to



*Besides the Excel, Broad Air Conditioning owns three Cessna 172s and a Citation 525. U.S. business jet manufacturers are hoping other Chinese businessmen will follow in the Zhangs' footsteps.*

regulate a transportation system used by the masses. That's why general aviation regulations are only now being drafted.

If bizjet sales truly follow the Zhang model, the purchasers will have not only wealth but at least an interest in flying; presently, in the Chinese population of 1.2 billion, fewer than 50 hold private pilot's licenses. (In the United States there are almost 620,000 pilots, and a number of organizations who speak to lawmakers on their behalf.) But in spring last year the first flight school for the general public—the Shanghai Eastern Aviation Educational Training Company, Ltd.—opened its doors. The school had one airplane, a Cessna 172. (It now has two 172s and one Beechcraft A-36 Bonanza.) The syllabus consists of 80 hours of ground school and 35 hours of flight training involving dual and solo flight. The price: about \$10,000, which members of China's nascent middle class are willing to pay. For the 50 seats available in the first class, more than 200 people, including 25 women, applied. Another school recently opened in Guangdong, near Zhu Hai. "There is definitely money around here," says Joe Stewart, a Cessna rep who sells 172s.

Flying clubs for aviation enthusiasts have existed for some time in China, but because the PLA and CAAC have

granted only minimal airspace usage, when club members meet, they talk more than fly. In Shanghai, students of the flight school are allowed to fly within a 14-mile radius of the airfield and under 1,000 feet. Nevertheless, the Shanghai and Guangdong flying schools will be graduating licensed private pilots who have every intention of taking to the air, and who, as members of an increasingly important (i.e., prosperous) class, may make their voices heard in Beijing.

But in skies that are truly general-aviation-friendly, there is always some uncontrolled flying going on, and "China's policy right now is that all flying is under control," says Keck. "So right away there's a public policy issue."

"People in the government need to be convinced that more small aircraft is not necessarily a safety issue in any form," says Zhang Yue. Ironically, government restrictions may actually be creating a safety issue. Ron Waterman, an FAA Flight Standards Operations Inspector, visited the Shanghai flight school and, while noting the obvious enthusiasm and seriousness of the program, listed in his report "some concerns over the flight training syllabus." There are no provisions for upper air work, like stall recovery, or for emergency landings. Asked about these gaps, school officials say they just don't have

enough airspace to work in. They say they've been talking to the CAAC about getting more—roughly double what they now have—but the request has not yet been decided on.

Gulfstream's Roger Sperry sees changes ahead: "People here are now beginning to feel okay with the concept of business aviation, meaning they understand that there's a legitimate role for business aviation in helping the Chinese economy grow."

China's western region, for example, accounts for 60 percent of the country and features some of China's more interesting small cities and areas, which are underserved by the airlines. The potential for tourism, therefore, as well as other business opportunities, remains unexploited. China's airlines, according to FAA officials in Beijing, would like to help develop the western region mostly through chartered general aviation aircraft. Because of the clearly practical benefits the idea offers, the government has decided to construct some 20 airports throughout the west specifically for general aviation aircraft and helicopters.

But open skies for bizjets? Open doors for buying and importing them? Not yet. The Zhang brothers have certainly shown what's possible. But the Zhangs are still the exception to the communist rule.



# The Avengers

They torpedoed enemy ships  
during World War II.  
Now they fight fire.

by Marshall Lumsden

Photographs by Chad Slattery

# A screech from the loudspeaker pierces the air, followed by the matter-of-fact voice of the dispatcher: “*We have an action call.*”

The flight leader sprints to the flight line, followed by other pilots and air-crew. Within two minutes, three Grumman TBM Avengers have fired up, and the lead airplane begins to taxi. I close my eyes and listen to the rising and falling chorus of 1,950-horsepower Wright R-2600 radial engines. I can imagine this roar on a carrier deck as the squadron prepared for battle in the Philippine Sea 57 years ago. Soon these sounds will be only a memory.

We are, in fact, at Miramichi Airport, a former Royal Canadian Air Force base in eastern New Brunswick, near the Gulf of St. Lawrence. The

Avengers, neatly painted in white and gray with yellow wingtips, are tankers, the last working survivors of their breed. They line up by large storage tanks at the edge of the ramp, where 625 U.S. gallons of fire retardant—a slurry of red dye, fertilizer, clay, and water—are rapidly pumped into bomb bay tanks. One by one they take off, climb to about 1,500 feet, and vanish over the southern horizon on their way to a newly reported forest fire.

**O**n December 15, 1941, the Avenger prototype made its first successful flight. The first production models, coming off the line in early 1942, were TBFs (“F” being the U.S. Navy’s designation for Grumman Aircraft, the manufacturer). In 1943, Eastern Aircraft, a division of General Motors in Trenton, New Jersey, began to manufacture them simultaneously as TBMs. In 1944 Eastern took over entirely. In September 1945, when production ceased, 9,837 Avengers had been delivered.

Built to strict Navy specifications as a

torpedo bomber to replace the obsolete Douglas Devastator, the Avenger carried a crew of three: pilot, navigator/radioman, and machinist’s mate/turret gunner. Its internal bays could carry 500-pound bombs or a 2,000-pound torpedo.

The Avenger played a major role in defeating the Japanese fleet in every campaign in the South Pacific. Along North Atlantic shipping lanes, Avengers operating off escort carriers went on the offensive against German U-boats, making the sea safer for merchant ships. By the end of the war, pilots had come to appreciate the ruggedness and stability of the seasoned battler, which could take savage punishment and still make it home. Among some pilots, though, its ungainly appearance earned it the nickname “turkey.”

“I always referred to it as ‘the great iron bird,’ the only completely cast iron airplane ever designed by man,” says Lee Pasley, today a retired businessman in Billings, Montana. As a 22-year-old lieutenant (junior grade), Pasley flew TBMs with U.S. Navy Torpedo Squadron One off the carrier *Yorktown* (the second one with that name) and the *Bennington* in the South Pacific. “It was a good, solid, honest airplane,” he says. “Nothing tricky about it at all. You could just walk her right straight down through from a dead stall and still have enough control to keep the wings level. Was it a good airplane? I’m still here.” Two days before the war ended in the Pacific, Pasley was shot down by anti-aircraft fire over Tokyo Bay and held prisoner by the Japanese.

Probably the most famous Avenger pilot is former president George H.W. Bush. Shot down during an attack on a Japanese-held island in September 1944, Bush bailed out and was rescued by a U.S. submarine.

The Avenger served the U.S. Navy until 1954. In the 1950s, under the Mutual Defense pact, TBM-3s were sent to Canada, the United Kingdom (which had used them during World War II as well), the Netherlands, France, and Japan, for the Japanese Self-Defense

*Ready for New Brunswick’s four-month fire season, a fleet of Grumman TBMs outfitted as tankers awaits the battle call.*

Force. The latter were the last TBMs to leave military service, retiring in 1962.

In 1956, the U.S. Forest Service picked up eight surplus TBMs and began to test them as tankers for fighting forest fires. Powerful, rugged, and spacious, TBMs could reach blazes in places that were not accessible to firefighters on the ground. Because surplus TBMs were cheap, entrepreneurs in the Western states bought them up, equipped them for spraying and firefighting, and contracted their services to federal and state governments.

Meanwhile, in the province of New Brunswick, where 83 percent of the land is forested and wood products are a mainstay of the economy, annual infestations of budworms threatened stands of spruce and fir. Forest Protection Limited was formed in 1952 and initiated a spraying program. In 1960 the company began to replace the fleets of slow Stearman biplanes it had been hiring on a seasonal basis with the more effective TBMs, and by 1977, FPL owned 23 Avengers. Around 1990 the budworm hit the bottom of its natural population cycle, and the TBMs were devoted almost exclusively to firefighting.

Today there are only seven TBM tankers left flying in New Brunswick. Three more are at the company hangar in Fredericton being readied for delivery to buyers, one a private collector in France. David Davies, the genial general manager of FPL, discusses the economics of their long survival: "We had a real public debate here in 1990 when we put these TBMs on as fire tankers," he says. "They were saying these were old aircraft. We're saying these are young aircraft. There's three to six thousand hours on the airplane. That's it. We've got 11 good years out of them. One more year and they've done their job. These were all purchased in the 1970s for twenty to twenty-five thousand dollars apiece. Even

*It looks like a torpedo bomber. Except for removal of the guns, the modifications to create an air tanker were made under the skin: altering hydraulics, moving batteries to the rear of the fuselage, and adding drop-tank controls.*





*Firefighting pilots keep their skills sharp with practice drops (top).*



*To prevent retardant leakage, mechanic Jeff Wright services the tank doors. In two minutes, 625 gallons of retardant flows from tank to TBM (below).*



when you add a \$130,000 per airplane conversion, what's that against these new aircraft in the \$1.2 million range?"

Miramichi Airport, the summer base for FPL's Forest Fire Air Tanker Operations, is 45 minutes by Cessna 172 to the northeast of Fredericton. From 800 feet above the terrain, all you can see of New Brunswick looks like a forest. Here and there are a small village, an isolated house or a stump-filled patch of clear-cut, and a highway along a meandering river. The green landscape rolls gently away on both sides.

At Miramichi, two flights of three TBMs are parked in rows facing each other across the ramp. They look sleek and well-cared for, but no longer very warrior-like. The gun turrets have long since been removed, and the canopies failed to cover the gaps. Aft of the cockpit, the windows of the navigator's compartment have been painted over.

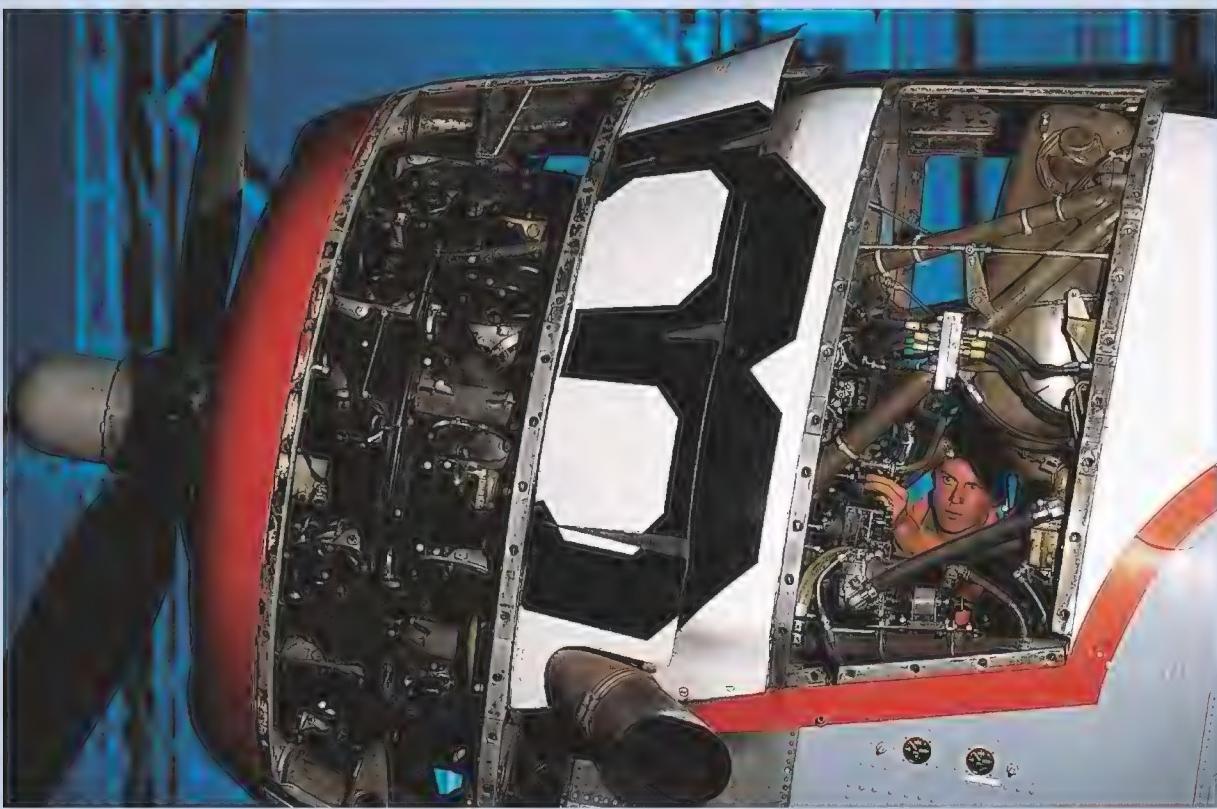
Chief pilot Eric Bradley explains how they work: "Initially, someone will spot a forest fire in New Brunswick somewhere and they'll call in to the dispatcher at this base and request tankers for air support. We're sitting around goofing off, joking and pretending everything is normal. When the siren goes off, everybody goes into action."

From here, you can jump in a TBM and fly anywhere in the province in less than an hour. If the fire is far enough away, the aircraft will shift operations to one of 11 satellite airstrips, most of which are equipped with storage tanks filled with aircraft fuel, retardant, which is dropped on the unburned vegetation surrounding a fire to make it fireproof, and foam, which is used to douse a blaze. Each firefighting flight includes three TBMs and two support aircraft: a Cessna 337 Skymaster and a Cessna 210 or 206.

FPL's strategy is to attack a fire quickly before it gets out of hand. The Skymaster is airborne ahead of the others. An air attack officer, a forester with expertise in fire behavior, sits in the right seat. He will reach the fire first, size it up, make contact with the ground crews if they are there, and direct the TBMs when they arrive. The Cessna 210, carrying a mechanic and two crew members to refill the retardant tanks, heads for the appropriate satellite field,



*Mechanic Pat Greene became enamored of Avengers as a teen. He supervises a crew of eight, including Jonathan Foran (below, checking on an engine).*



*Below: What remains of a piston (left) and a connecting rod is evidence of the fortitude of the Avenger's Wright R-2600 radial engine. Shortly after takeoff, the connecting rod was sheared off, releasing the piston, which was melted by the heat of the engine. The pilot landed safely.*



which will usually be within 10 or 15 miles of the fire.

"It takes only two or three minutes to load [retardant]," says Bradley, "and a total of about six minutes to get airborne, including the time for warmups and runups."

Around three in the afternoon, the fire siren sounds. I run for the Skymaster. This is my chance to see the TBMs in action. Pilot Glen MacDorman is already in the Skymaster's cockpit, preparing to start up. He motions me to the rear seat. Air attack officer Bob Steeves sits beside him.

The dispatcher tells us the fire is at Little Sevogle River, about 22 nautical miles from the airport. Even as the Avengers are being filled with retardant, we are on our way, heading northwest at about 1,000 feet. MacDorman starts to enter the coordinates relayed by the dispatcher into the Global Positioning System unit when we spot the smoke ahead. The GPS, a Garmin GNC 250 navcom, is the most sophisticated piece of equipment on the TBMs. The readout can give the pilot the heading, track, distance off course, ground speed, and estimated time of arrival, as well as bearing and distance to the fire.

We make a steep right around the head of the fire at about 500 feet. It is a small one, not more than a couple of acres, probably started by campers or fishermen. But the tops of the taller trees are already ablaze, and unless the fire is put down, it can spread quickly. A ground crew is already working at the scene. Nearby a female moose stands placidly in the middle of a small pond.

The tankers radio that they are on the way, and the fire attack officer decides he wants the first tanker to hit the head of the fire. MacDorman switches on the siren to warn the ground crews. (A full load of fire retardant can knock down a large tree.)

The TBMs come in one at a time. They make their pass at about 125 mph with wing flaps set at 10 degrees. The pilots can drop the full load of 625 gallons, or drop half on the first pass and the rest on a second pass. Or they can drop a "string load," which is one half followed immediately by the remainder. Drops are usually made at an al-

titude of 100 feet or less. The fire retardant is not intended to extinguish the fire but instead to isolate the fire by creating breaks in its path. Once the fire is surrounded by a ring of retardant, the burning areas inside are extinguished with foam.

Tanker 13, piloted by flight leader Erwin Joyall, comes in first. We bank sharply over the TBM's flight path and drop down to follow alongside and just above him to the drop. It feels like we are in a dogfight at treetop level. Joyall drops a full load, making a good hit on the head of the fire, and climbs away. The cabin of the Skymaster is filled with the smell of wood smoke.

The second and third tankers are directed to drop retardant along the fire's flanks to pinch it off. The third tanker is flown by Bob Blanchard, a temporary pilot who is working his first fire. He hits his target. "Not bad

for the first time out," observes MacDorman.

Steeves asks the tankers to refill with foam. In a few minutes they are back again to make drops directly on what's left of the fire. By the time we head back to Miramichi, the blaze has been doused. Only strings of white smoke drift up from the blackened patch of woods. MacDorman radios to the ground crews, "It's all yours now."

The fire season in New Brunswick starts around the first of May and ends in mid-September. Pilots contract to work only during that time, during which they earn a base salary plus pay for the hours they fly. Flying time ranges from 60 to 100 hours for the season, depending on fire conditions. "They'll make the money and then they'll all quit flying through the winter," says chief pilot Eric Bradley.

"Most of them will stay at home and do other things they want to do."

Pilots based at Miramichi have no scheduled days off during the season. Seven days a week, they gather in the operations headquarters building about noon. After meeting in the conference room, where they read the weather forecast and fire hazard reports, they wander into the lounge or out to the flightline to check their aircraft. Most of the time they wait, talking shop. The all-clear usually sounds about 6 p.m.

The pilots are Canadian; most are from New Brunswick. All are middle-aged. Conversations are in English, often tinged by the inflections of Acadian French or the throatier accents of the Québécois. Their collective flying experience is impressive—none is military, but they have logged thousands of hours of low-altitude, single-engine time as instructors, bush pilots, cropdusters,

*Pilots Ron Clowes, Claude Fournier, Eric Bradley, John Gomany, Glen MacDorman, and air attack officer Gilles Chaisson (left to right) are based at Miramichi during the summer fire season.*



tanker jockeys, and charter pilots.

"This is blue-collar flying," says Bradley. "Some people look down on it but we love it. You get your hands dirty. There's no epaulets, there's no white shirt and tie. These pilots actually work. I think the guys who do this, they're more type-A personalities. They get bored easily. They need that constant stimulation of takeoff and landing. They think of themselves as stick-and-rudder pilots."

Bradley himself is a former member of a championship Canadian skydiving team, with more than 3,000 jumps. Twenty years ago he gave up a job as a biology teacher and turned to cropdusting. "My father was a private pilot

"Commercial Pilot. Fire Bombing. Spraying. Bush. Charter. Advanced Flying Instruction. Test Pilot. Fly Anything Anywhere. Single and Multi-Engine. Wheels. Skis. Floats." Gomany has flown 55 types of aircraft and logged more than 10,000 hours. He has been working for FPL for 25 years and has over 1,500 hours in the Avenger.

Because the Avenger's high tail wheel lowers its rather short nose, visibility inside the roomy cockpit past the big radial R-2600 ahead is excellent. The rear compartment is something else. The pilot's seat blocks the forward view and the canopy behind me is painted over, so the best visibility is to the sides. I pull the battered helmet down

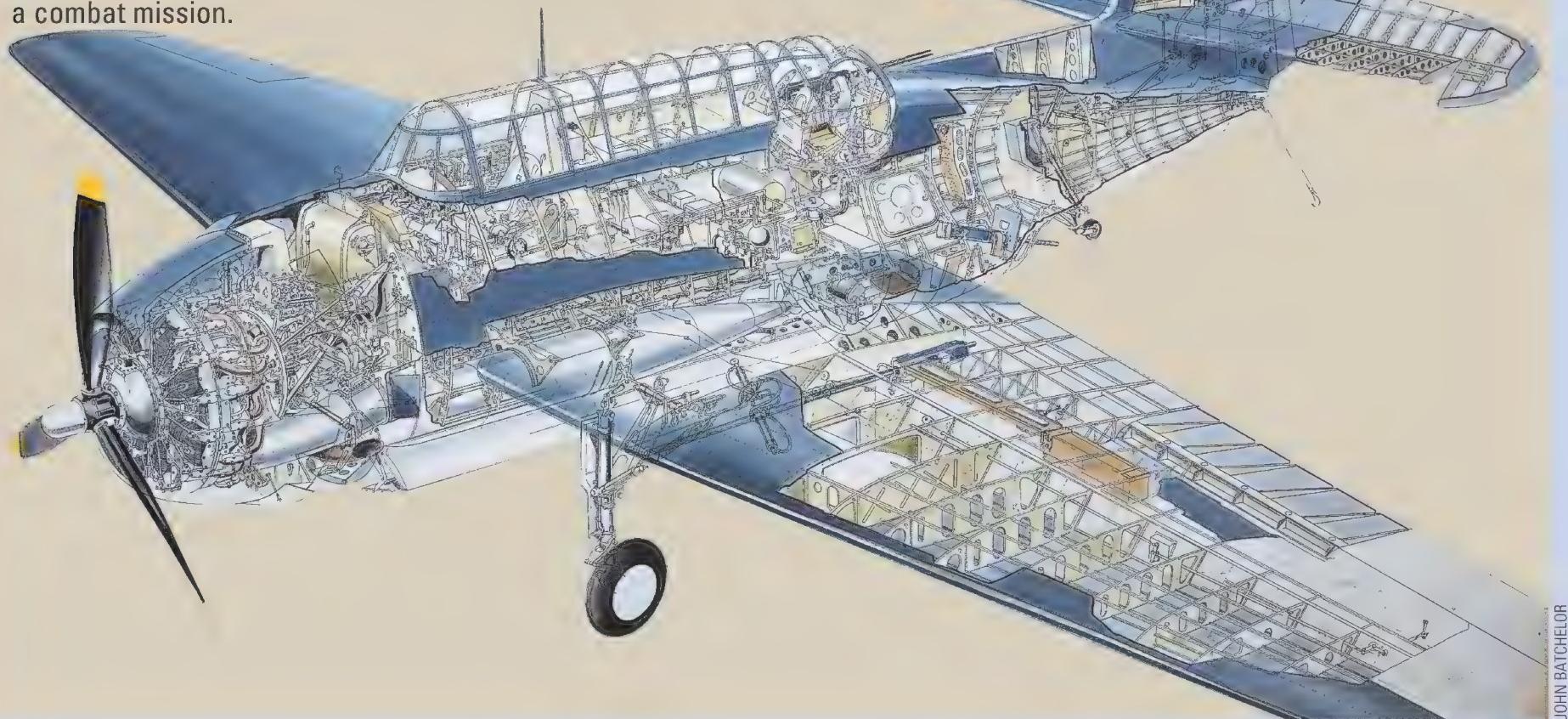
surprises me by lifting off smartly from three points after a run of about 1,200 feet. Within a few seconds, I have the sensation that the airplane has been carved from a solid block. It feels tight and stable in the air. Later, when I ask pilots what it's like to fly, they describe a similar feeling.

Bobby LeBlanc, who began flying Avengers in the late 1970s, says of his first flights: "At first it seemed like a lot of noise in the cockpit, and you were sitting very high and the attitude seemed strange, especially when you were taking off. Once you got that solved, it is like flying a Super Cub, actually. It is very stable."

But nimble it is not. All agree that it

## Plucked Turkey

Designed to attack surface ships and submarines, the Grumman TBM Avenger was a carrier-launched bomber with an internal bay that could hold up to 2,000 pounds (either one torpedo or 500-pound bombs). It took three airmen—pilot, navigator/radioman, turret gunner—to fly the craft on a combat mission.



JOHN BATCHELOR

and had a Tiger Moth," he says. "I was weaned on that. I have it in my blood."

Offered a ride in an Avenger, I accept happily. Tanker 23 has had the rear crew seat reinstalled, and it is the only TBM that can carry a passenger. The pilot is John Gomany, a young-looking 60-year-old grandfather from Alberta. He hands me his business card:

over my ears (there is no intercom) and strap into an old seat-pack parachute that will serve more as a seat cushion than anything I might actually use in an emergency.

Gomany taxis out. Steering on the ground is done with the brakes since the swiveling tailwheel turns freely until it is locked for takeoff. The TBM

is heavy on the controls. Every change in speed and power requires a constant hand on the trim wheels. "You have to stay on top of it all the time," says Eric Bradley. "You have to show it who's boss."

Aloft, Gomany points the nose eastward and we head out briefly over the sun-dappled waters of Northumber-

land Strait toward the Atlantic Ocean. Back at Miramichi, he eases into the pattern and lands smoothly. When we are down, it occurs to me that I wasn't aware of the wheels coming up or down. Gomany confirms that after more than 50 years, the old machinery still works without a creak. Two small rods recede into the tops of the wings to indicate the landing gear is down, at which point the pilot can feel the change in air resistance.

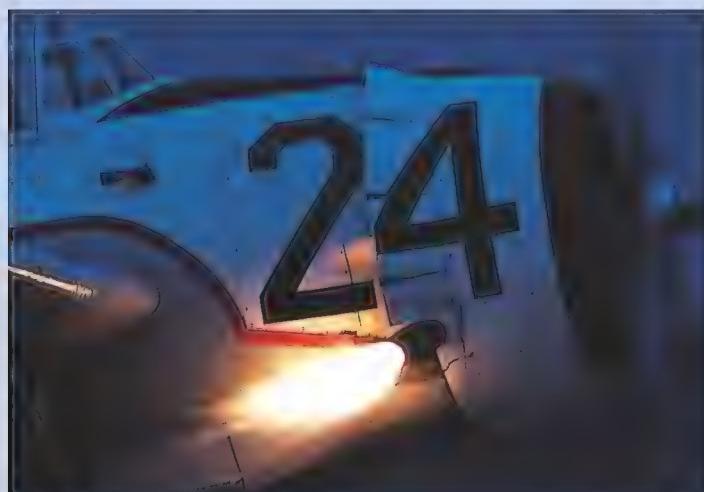
Almost before we have come to a stop on the line, Patrick Greene is crouched on the wing to talk to the pilot. He is the chief inspector, in charge of keeping the old birds running. He is actually an employee of Woodlands

"The pilots and us [his crew of eight], we've known each other for a long time, so we rely on each other a lot," he explains. "Every night when they come back, we talk to each one of them for 15 minutes while they're still sitting in the seat. I'm with them all the time. You talk to them and you know the problem."

Listening to each Avenger on the ground, he can diagnose a problem with an engine, and most of the time he can come close to pinpointing which cylinders are performing under par. He can also tell who is flying an Avenger as it comes in to land because he can recognize the engine settings preferred by individual pilots.

of changes. When they were converted to tankers, they underwent many alterations. Gun turrets were removed to save weight, gun mounts were taken out of the wings, hydraulic systems were altered, weight was shifted to compensate for the change in the center of gravity, wing-folding actuators and hydraulics were removed, batteries were moved to the rear of the fuselage to add ballast, and drop tank controls and gauges were added.

And yet, stuff happens. In his office, Greene reaches into a desk drawer and produces two metal objects. One is half of a massive connecting rod cleanly sheared off and partially split. The other looks like a small baked potato



*When an Avenger's throttle is retarded, excess fuel burns and exits via the exhaust.*

*"This is blue-collar flying," says chief pilot Eric Bradley (right).*

Aviation, which maintains the TBMs under contract to FPL. No matter; it would take more than a mere contractual arrangement to come between Greene and these beloved machines.

Greene's relationship to the TBMs is longstanding and deeply intuitive. So is his communication with the pilots. Indeed, his best tools seem to be his ears. "If you're willing to listen," he says, "I don't think there's anything you won't know long before the pilot does. Even if you never looked, you can hear it." Greene is at the loading pit every time a flight comes in, listening intently to the sound of each engine. "Each time these guys come in here to reload, they want to keep an eye on you to see the nod that it's okay," he says.



Greene has had a love affair with TBMs since he was in the ninth grade, when he used to skip class to come out to the airport and hang around, handing up tools and parts to the mechanics and wiping down the airplanes. "I think they got sick of me, so they hired me," he says. In 1994, he became the head of maintenance.

"They're a forgiving airplane to work on," he says. "There's nothing hard about it. The U.S. Navy structural manual is the best I've ever seen. It doesn't matter what you do, whether you have to change six inches of a stringer or a rib. It's all in that book. The aircraft has lots of room to work in, and they're built so rugged they can withstand a lot of changes."

Certainly the TBMs have seen a lot

wrapped in foil, but in the hand it is heavy and solid, the remains of a piston melted by extreme heat.

To Greene, this is evidence of the TBM's toughness and durability. To others, including management, it might be a different kind of omen. Erwin Joyall was the pilot involved. "I was climbing out, just coming to 1,500 feet," he remembers. "The engine started making noise, and there was every type of smoke you could think of—black, brown, white. A big vibration, but it was still running some. I never pulled the power entirely, although I was expecting it to totally disintegrate any second."

He prepared to make an emergency landing in a swamp when suddenly the engine smoothed out a bit and seemed

to pick up power. Since he was not far from Miramichi, he headed back to the field at low altitude. He set down on the runway dragging a cloud of smoke that obscured the airplane. A wrist pin had apparently broken, releasing the piston. But after swallowing up the loose parts, the R-2600 had pulled itself together and carried on, while blowing a spectacular plume of smoke and oil out the stacks.

There are plenty of scary flying stories passed around about the bad old days, when maintenance was the responsibility of the contract pilots. Pat Greene remembers pilots who carried vise grips in the cockpit to hold things like hydraulic lines or controls together when they loosened or broke. I was told that 33 TBMs have crashed in the New Brunswick woods.

Bobby LeBlanc put one in the woods himself three years ago. "About 20 minutes out at 2,000 feet I heard a couple of bangs and I saw some smoke," he remembers. "There was oil all over my windscreen. I started to see flames coming out from the side of the cowlings. When I started diving down the fire went out. I found out later that the ring gear on the propeller had broken. Everything went out and I was just a glider, but it doesn't glide very well."

"I picked myself a nice spot at the end of a clear-cut," he continues. "I left my wings level and one wing caught the tree. It cut it off from the aileron out." The TBM kept going to the far end of the clear-cut and hit in the tops of some tall trees, then fell to the ground, landing at an angle. It was a jolt, but LeBlanc had his shoulder harness locked and the switches off (to prevent the



formation of sparks, which could start a fire). He is philosophical about the incident. "Any type of airplane, you're bound to have an accident," he says. "Nothing is perfect. We're fortunate we can still talk about it. Another type of airplane and we might not be here to tell it."

*John Gomany (left) has been a tanker pilot for 25 years, logging more than 1,500 hours in TBMs. It's unlikely he'll retire on the Avenger (above), though. The old bird's days are numbered.*

Most of the pilots will be sad to see the sturdy TBMs go. Nobody will miss them more than Pat Greene, though. "They're like your children," he says. "They're all different, but you love them all. I was joking with [general manager] Dave Davies—well, I wasn't really joking, but I said if he would keep one TBM, I'd work on it for free."

By mid-summer, the future was sitting brazenly on the ramp near the old Avengers—a brand-new Air Tractor 802F, embodying the latest technology in tanker/sprayers. Powered by a 1,420-horsepower Pratt & Whitney tur-





boprop engine, it can carry 800 gallons. It can drop its load in 50-gallon increments in any pattern for up to 16 separate drops, and for spraying it uses a GPS system that is accurate within a few feet. The pilot can monitor it all on a screen in the cockpit.

Moreover, the AT-802F has automatic flow control for the spray. Every movement of the flight is recorded, including where and when the spray is released and from what altitude. The airplane can deliver its load faster than the old Avenger, because close to the drop zone, it is more maneuverable.

And with its fingertip control, autopilot, and air conditioning, it is also more comfortable.

It doesn't impress Pat Greene. "Every one of the TBMs has a personality," he says. "That's what bothers me about the new one. It has no class, no personality to it."

Even after years of muscling them around, the pilots will miss the adventure of flying the Avengers. "Just because the Honda is smoother and more high-tech doesn't mean we wouldn't rather ride Harleys," says Eric Bradley.

Like the others, Bobby LeBlanc hopes against hope for more time. "Maybe with a little luck we can add a few more years," he says. "It's still a thrill to fly them. And we've saved a lot of trees and a lot of jobs for people working in the woods."

John Gomany admits that the 802 might be a good airplane to retire on. But, he says somewhat wistfully, "The one thing I want to do is to take off and land a TBM on a carrier deck. I know it could do it."

I hope, by some miracle, he gets his wish. 



## SIGHTINGS

**O**n July 17, 2001, renowned aviation photographer Judson Brohmer was killed near Edwards Air Force Base, California, when the F-16 he was flying in crashed. Brohmer, 38, who is survived by a wife and three children, was photographing an air-launched decoy test. His pilot, Major Aaron George, also died.

Brohmer had developed a reputation as an exceptional talent. "He never did the typical profile shot," says colleague Eric Schulzinger, a photographer and Lockheed Martin's director of multimedia communication. "He always got a new and interesting angle. And when I'd look at his film, every frame was tack-sharp. The odds of that are very poor."

One of Brohmer's most dramatic images shows an F-16 in a full-afterburner vertical climb with the sun setting in the background (opposite). "The timing on this one is just phenomenal," Schulzinger explains. Brohmer also shot the F-22 Raptor for Lockheed Martin (right, top). Writing about the experience on his Web page, he said, "The pilots are what make it happen. Every picture I'm proud of has a story behind it [about] how the pilot put us in that particular position—and often it was no small feat."

His portrait of a rare formation of F-117 stealth fighters was yet another feather in his cap (right, middle). F-117s don't have speed brakes, so it's dangerous for them to fly in formation. Yet the Air Force wanted the shot, and knew that Brohmer could get it quickly and with little fuss. Finally, Brohmer's self-portrait, taken while flying in an F-16 over Tehachapi, California, is testament to the pleasure he took in his profession (right, bottom). "Nothing compares to the feeling of skimming over wispy clouds or being down on the deck as my F-16 rockets through canyons at two hundred feet," Brohmer wrote.

Though his career was brief, Brohmer left behind thousands of images that come tantalizingly close to capturing that very feeling.



# Cold War Whispers

## The Price of Vigilance

by Larry Tart and Robert Keefe.  
Ballantine, 2001. 656 pp., \$26.00  
(hardbound).

**W**hen an American EP-3E Aries II surveillance aircraft was forced down on Hainan Island, China, this year after a harrowing mid-air encounter with a fighter that took the life of a Chinese pilot, the U.S. government minced no words—it acknowledged that it conducts aerial reconnaissance flights on a routine basis and blamed Beijing for the mishap (see “Relief Flight,” *Above & Beyond*, p. 18).

It was different in the 1950s. Although U.S. military aircraft snooped on the fringes of the Soviet Union and its allies on a daily basis—and sometimes flew over Soviet territory—the formal policy at the time was to deny such flights were taking place. The Air Force and other services trained thousands of airmen in foreign languages, sent them aloft to monitor Soviet bloc communications, and shrouded their work behind a cover story that the fliers were “studying radio wave propagation.”

On September 2, 1958, Soviet MiG-17 fighters shot down an Air Force C-130 Hercules over Soviet Armenia, killing all 17 crew members, many of whom were trained as Russian-language radio intercept operators.

Yet even after President Dwight D. Eisenhower authorized the release of tape recordings of the Soviet pilots making the kill, the public was not told that the Hercules had been on a reconnaissance mission. Even more chilling than those recordings are photos—published in *Price of Vigilance*—taken from Soviet MiG gun cameras that show the C-130 being blasted out of the sky (above, inset).

A beautiful book about a tragic subject, *Vigilance* began strictly as a history of the 1958 shootdown. But Larry Tart and Robert Keefe, both veterans of the unit to which the C-130 belonged, expanded their



USAF, INSET: SOVIET ARCHIVES

work, taking us into the secret world of air reconnaissance. The authors use plain English, making a specialized subject easy for the general reader to understand.

Among other achievements, *Vigilance* lays to rest the rumors that swirled around the C-130 shootdown. Was the C-130 crew assigned to fly into Soviet airspace? Or did they blunder across the border, possibly because they'd only recently made the transition from another aircraft (the RB-50 Superfortress) and had little experience with their factory-fresh C-130? *Vigilance* answers these and other questions and reveals the workings of the super-secret National Security Agency, which oversees much of the nation's aerial reconnaissance.

This remarkable look at the cold war is faithful to the air crew and the events of the era, but like any published work, it contains a few inaccuracies. A chart meant to explain U.S. military ranks contains errors. The book identifies the Rosebowl reconnaissance program as “Rice Bowl.” The name of Andersen Air Force Base, Guam, is spelled incorrectly.

The book also reads, at times, like a compilation of anecdotes rather than an integrated history. But exciting anecdotes they are. *Vigilance* is an important work on an especially secretive corner of the cold war.

—Robert F. Dorr was an Air Force Korean-language radio intercept operator in the 1950s.

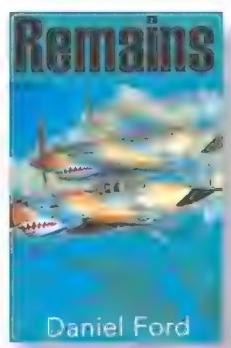
## Remains: A Story of the Flying Tigers

by Daniel Ford. Authors' Choice Press ([www.iuniverse.com](http://www.iuniverse.com)), 2000. 229 pp., \$15.95.

**I**t's a pleasure to read a well-researched novel based on real events. In this case, the “real” part is the brief defense of Rangoon mounted by the American Volunteer Group (Flying Tigers) and the Royal Air Force in the autumn of 1941, as the Japanese army overran Southeast Asia.

*Remains* begins with the discovery of a Flying Tiger P-40 in the jungles of Thailand, presumably at the present time, more or less. The book is a well-told tale of what happened to some of the pilots who tried to hold back the Japanese attack on Burma, and of the friends, acquaintances, lovers, and enemies whose lives they touched.

In fact, a few of the characters are real people, such as Claire Chennault, George Marshall, Hap Arnold, and the legendary Jumbo Majumdar, who has already been the subject of several worthy books. Despite the usual denial up front, other characters are based on real people, and it's fun to work out who they are. Having

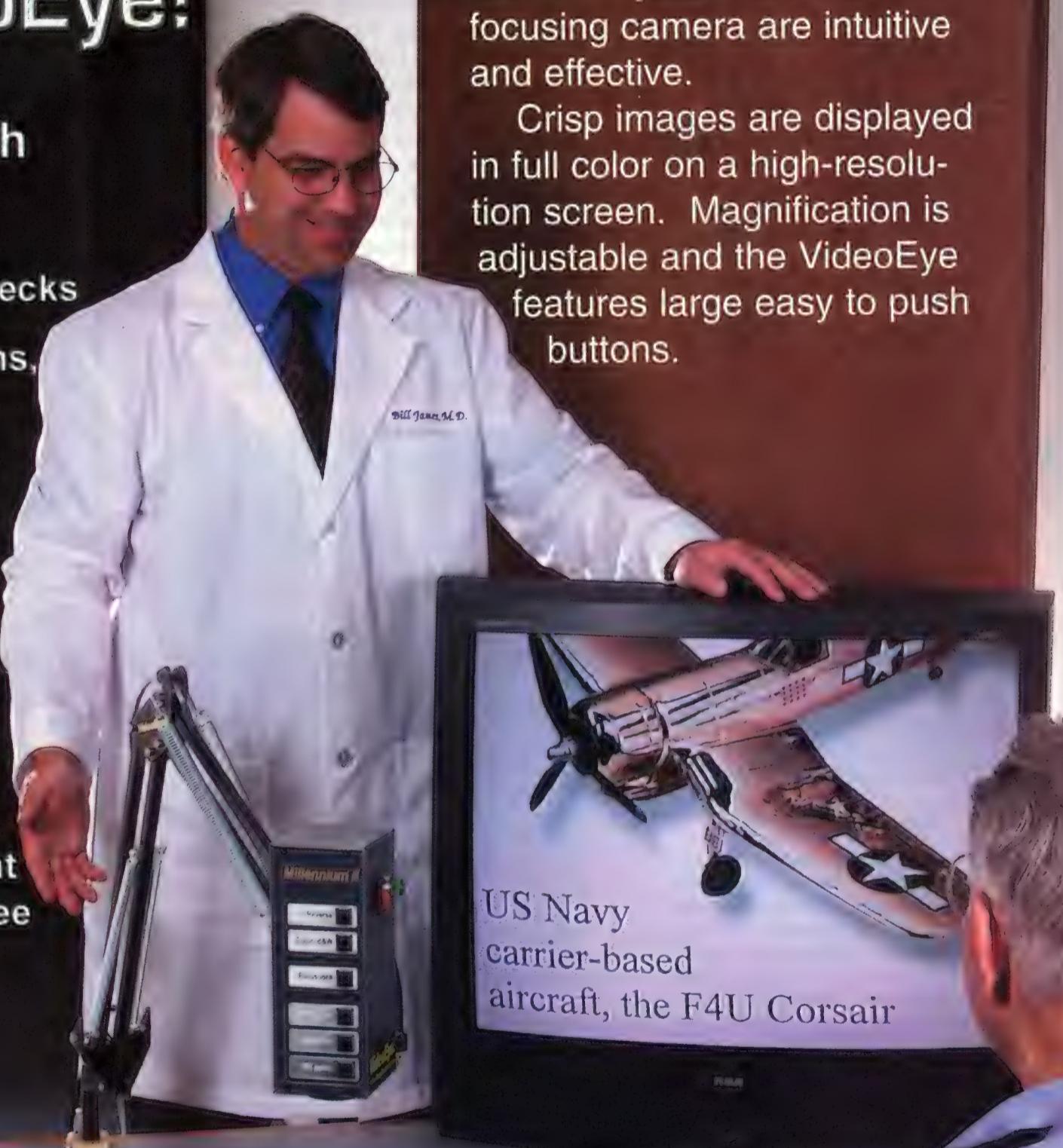


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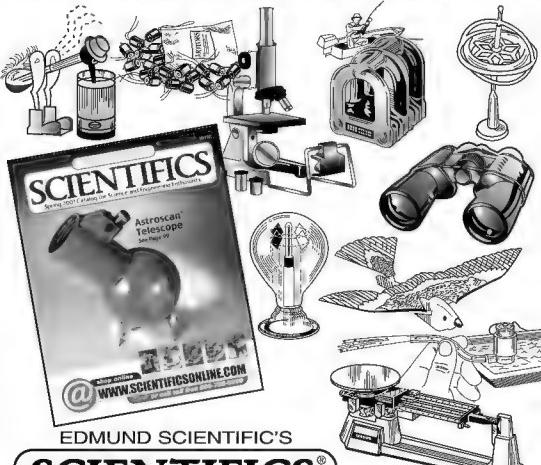
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## REVIEWS & PREVIEWS

spent some time chatting with Tex Hill only a few days before reading this book, I had no difficulty figuring out that he was the model for the Tex Murdock character. I thought I spotted my old pal, the late R.T. Smith, along with Ed Leibolt or maybe John Petach, both of whom were killed in real AVG action.

While the guessing game is fun, it isn't the best reason to read *Remains*—the story is. It is concise, the characters are easy to keep straight, you can read about the actual events elsewhere, and—best of all—it's a cracking good yarn about interesting people, including the Japanese fighter pilot whose story adds special realism to the battles.

Years ago, the historical novel genre supported several writers, such as Frank van Wyck Mason, Kenneth Roberts, and C.S. Forester, whose research and thoughtful character development put their books at the top of some very selective reading lists. Daniel Ford is such a writer and, as it happens, is more qualified than most to base a novel on the real Flying Tigers. His history, *Flying Tigers: Claire Chennault and the*

### CLASSIC AIRLINERS

**Boeing 377 Stratocruiser**  
by Nicholas A. Veronico. Specialty Press, 2001.  
104 pp., \$16.95, b&w and color photos (paperback).



**De Havilland Comet**  
by Kev Darling. Specialty Press, 2001. 104 pp., \$16.95, b&w and color photos (paperback).



Both additions to Specialty's Airliner Tech series highlight beautiful—and controversial—airliners: The Stratocruiser was dogged by cantankerous Pratt & Whitney R-4360 engines and troublesome Hamilton Standard propeller blades; an early string of Comet crashes allowed the Boeing 707 and Douglas DC-8 to become the predominant early jetliners. *Boeing 377* contains a remarkable series of photos—snapped by a Coast Guard cutter captain—of a Pan Am Stratocruiser successfully ditching in the Pacific Ocean after two engines failed.

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*American Volunteer Group*, is, without question, the most readable and complete account of the AVG yet written. He also has written about the AVG for *Air & Space/Smithsonian*, and, in the interest of full disclosure, it should be noted that he is a contributing editor to the magazine—although not one whom this reviewer has met.

Good novels about World War II, and especially its more obscure actions, are increasingly rare as its participants and events fade into history. This is among the good ones.

—Thomas F. Norton is a former Naval Reserve aviator who currently edits a regional flying magazine, *The Southern Aviator*, from his hometown, Easton, Maryland.

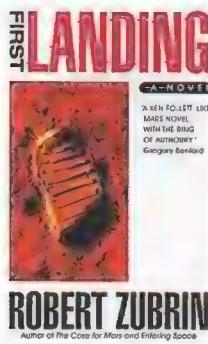
## First Landing

by Robert Zubrin. Ace Books, 2001. 262 pp., \$21.95.

**F**irst *Landing*, a novel about the first human mission to Mars, has all the hallmarks of a novel with an agenda: It was written by the driving force behind the so-called Mars Underground, Robert Zubrin, it is set a decade into the future and makes references to "historic" events and publications of recent vintage, and its characters make observations that are clearly intended to support current arguments in favor of such a mission.

Zubrin, a former Lockheed Martin engineer who founded the Mars Society, will likely make no apologies for any of this—What else would you expect from someone in his position?—and he doesn't really need to. His agenda is woven into the novel with respectable restraint, and *First Landing* is actually a pretty good read. It's a tidy little adventure, complete with hair-raising spacecraft descents, high-speed rover expeditions, perilous rock climbing, sabotage, political intrigue, and lots of romance, conflict, interpersonal friction, frantic problem-solving, and occasional philosophizing among the crew.

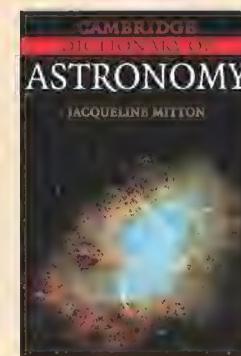
The novel takes us to Mars with the crew of the *Beagle*, and the first few chapters spell trouble for everyone. The predictably motley bunch—Colonel Andrew Townsend, a hard-charging Air Force pilot; Major Gwen Llewellyn, the tomboyish flight engineer; Dr. Rebecca Sherman, the beautiful biologist and



## SPACE FROM A TO Z

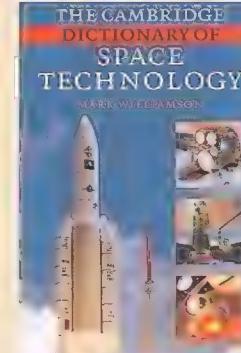
### The Cambridge Dictionary of Astronomy

by Jacqueline Mitton. Cambridge University Press, 2001. 468 pp., \$18.95.



### The Cambridge Dictionary of Space Technology

by Mark Williamson. Cambridge University Press, 2001. 464 pp., \$39.95.



Both of these well-illustrated, intricately cross-referenced volumes are valuable aids for space enthusiasts. Each contains up-to-the-minute definitions—scores of entries that likely did not appear in even the most recently published dictionaries. *Space Technology*, in particular, is useful for its comprehensible explanations of many components of space travel that undoubtedly baffle some of its most ardent enthusiasts. Indeed, these are the kinds of dictionaries you can read for fun.

doctor; Luke Johnson, the redneck geologist from Texas; and Professor Kevin McGee, the crew's historian and adventurer—apparently thought very little about what they would do once they landed, as they begin squabbling over who should be the first to set foot on Mars and whose science missions should be the first pursued. Sherman wants to look for signs of life, while the outspokenly religious Llewellyn sides with the geologist, who would rather examine rock samples to learn about the planet's history. "The Earth is the only planet with life on it," says Llewellyn. "It says so in the Bible—or didn't you read that at Radcliffe?"

In *First Landing*, NASA doesn't put much thought into the crew's composition—not much thought beyond job titles, anyway. But Zubrin recovers from this in short order, and Sherman gets her chance to seek out Martian life. She promptly finds it, and inadvertently sets off a political firestorm on Earth. Public opinion turns against the crew, as it is feared that they have been contaminated with Martian microbes

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that could wipe out life on Earth should they be allowed to return. Political infighting begins at the executive level, and eco-terrorists stage a destructive riot at NASA's Johnson Space Center. One of the terrorists even manages to hack into mission control's computer and send to the lander's computer barely detectable commands intended to kill off the crew—emptying fuel tanks, replacing oxygen with helium, etc.

Amid such outlandish twists in the plot, the science in *First Landing* is pretty sound. Zubrin is the last person whom you'd expect to take poetic license with a science-based plotline. But he manages to string together a series of problems and solutions that ultimately make sense. The arguments between the crew members are laden with appropriately technical jargon, but it is well explained.

*First Landing* might, unfortunately, be a victim of its own timing. Though a year ago it seemed that Mars was about to take hold of the public's imagination, the two big-budget movies that came out promising to encourage this interest—*Mission to Mars* and *The Red Planet*—fell utterly on their faces, thanks to wildly implausible scenarios and horrible acting and direction. *First Landing*, a slim novel written by perhaps the only individual on Earth who could pen a scientifically plausible yarn about the Red Planet, could have saved those screenwriters considerable effort.

—Eric Adams is an associate editor of Air & Space.

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**Relief Flight.** Vincent Czaplyski is a captain for a major airline, living and writing in Exeter, New Hampshire.

Tom Pinardo is chief pilot for Continental Micronesia and continues to fly the far reaches of the Pacific from his home and base on Guam.

**Closer to Mars.** David S.F. Portree writes about space exploration and astronomy from Flagstaff, Arizona.

**All and Nothing.** Japanese-born Thomas S. Momiyama retired after a career with the U.S. Department of the Navy and now works as an aviation advisor and writer. He provided significant assistance to the Seiran restoration project by translating Japanese documents.

**Aichi M6A1 Seiran Poster.** Commercial illustrator and aviation enthusiast Harry Whitver thinks the best aviation job would be working as an aircraft restorer for the National Air and Space Museum.

**How Things Work: Celestial Navigation.** Joe Henderson is a US Airways captain. He has been studying celestial navigation for 15 years.

Further reading: *Song of the Sky*, Guy Murchie, Houghton Mifflin, 1954.

*Taking the Stars: Celestial Navigation From Argonauts to Astronauts*, Peter Ifland, Krieger Publishing Company, 1998.

**The Mirror Makers.** Ben Iannotta is a freelance journalist and aspiring back-country fishing guide living in Summerland Key, Florida.

**Restoration: Unearthing a Diamond.** Becki Bell is a student pilot and history enthusiast living in San Jose, California.

**Unbreakable.** Cory Graff is a freelance writer and researcher. He is the exhibits research and development manager at the Museum of Flight in Seattle, Washington.

**Stupid Plane Tricks.** Phil Scott is currently writing two books, *Dangerous Things*, about dangerous things, and *The Storm of the Century*, which details a hurricane that hit the Florida Keys on Labor Day, 1935.

David Clark is a freelance illustrator living in Virginia's Shenandoah Valley, where he absolutely loves the air and space.

**The People's Liberation Bizjet.** William Triplett, a freelance writer in Alexandria, Virginia, has written about aviation and space for *Newsday*, the *Washington Post*, and *Nature*.

**The Avengers.** A U.S. Army Air Forces fighter pilot stationed in North Africa and Italy during World War II, Marshall Lumsden became a magazine reporter and editor after the war. He is now a freelance writer in Malibu, California. He wrote about P-40s in the Oct./Nov. 2000 issue.



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## FORECAST



ERIC LONG & MARK AVINO

### In the Wings...

#### At the Controls

From a forthcoming book by National Air and Space Museum photographers Eric Long and Mark Avino, lushly lit cockpits—like that of the Gulfhawk II above—of the Museum's air- and spacecraft.

#### Young Turks

Evil eyes, Northrop F-5s, and an air demo team that's a Turkish delight.

#### The Other Space Ships

There could have been no voyage into space without these ships at sea.

#### F-100: Head of the Class

Fighter Weapons School, 1957: The author took a lesson in flying "the Hun" from the best pilots in the Air Force.

## CALENDAR

### October 4–7

Reunion: 310th Air Commando Squadron. Ft. Walton Beach, FL, (512) 794-0787.

### October 6 & 7

Confederate Air Force AIRSHO 2001. Featuring a World War II air power demonstration and the "Tora! Tora! Tora!" act. Confederate Air Force Headquarters, Midland International Airport, TX, (915) 563-1000.

### October 8–12

Reunion: 368th Fighter Group, 9th Air Force, World War II. Harrah's Casino, Reno, NV, (687) 333-0241.

### October 10–14

"Planes Over El Dorado" Unlimited Scale Racing Association Championship. El Dorado, KS, (316) 943-3463, [www.usra-racers.org](http://www.usra-racers.org).

### October 13

Airline Collectibles Show. Buy, sell, and trade airline memorabilia. Museum of Flight, Boeing Field, Seattle, WA, (425) 485-8780.

### October 18–20

Reunion: 27th Air Transport Group, World War II. Savannah, GA, (828) 891-5422.

### October 20 & 21

Wings Over Houston Airshow Festival. Ellington Field, Houston, TX, (713) 644-1018.

### October 24–29

Reunion: Eighth Air Force Historical Society. Harvey Hotel, Irving, TX, (505) 889-9418.

### November 11

Veterans Day Fly-In. Featuring a missing-man formation flyover. Flabob Airport, Riverside, CA, (909) 683-2389.

## ON THE WEB SITE

[www.airspacemag.com](http://www.airspacemag.com)



JIM KOEPNIK / EAA

If you didn't make it to Oshkosh this year, you missed seeing a stunning re-creation of a 1919 Vickers Vimy, but fear not! You can still view the Vimy from all sides—including the inside—in two QuickTime videos on the Web site. Also on the Web: At [www.nasm.edu/nasm/garber/aichi/aichi.htm](http://www.nasm.edu/nasm/garber/aichi/aichi.htm)—see details and discoveries from the 12-year restoration of the Aichi Seiran.



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# Adventures of a Flight Recorder

**W**hen a U.S. pilot attempts a record in anything that flies, the National Aeronautic Association observes the attempt, verifies the pilot's performance, and ensures that the flight is conducted under the sporting codes of the Fédération Aéronautique Internationale. Generally, these observations are conducted by the NAA's Contest and Records Board and Advisory Panel. A year after I started working for the NAA, I was invited to join the Advisory Panel. A few months later, I got my first assignment as an observer. It was a doozy.

In February 2000, Steve Fossett and two copilots attempted an around-the-world speed record in Fossett's Cessna Citation X jet. An observer had to go along to verify that they flew the course they had declared. On my first Valentine's Day as a married man (a fact my wife has not forgotten to this day), Fossett, his copilots, and I roared out of Los Angeles International Airport, headed east. Less than two days later, we arrived back at LAX from the west, having stopped in Bermuda, Morocco, Egypt, India, Japan, and Midway Island. Looking over their shoulders in the cockpit, I had verified that the crew had followed their flight plan. They achieved a record-breaking average speed of nearly 560 mph—including the time spent on the ground.

Fifteen months later, Bombardier Aerospace attempted a number of city-to-city speed records, with employees flying five of their aircraft to the 2001 Paris Air Show: a Global Express, a Challenger 604, and three Learjets—a

31A, a 45, and a 60. The aircraft would depart from different locations and were to arrive in Paris simultaneously. As an observer, I drew the Learjet 45.

As the sun peeked over the horizon in Montreal, Rod Lundy and Shawn Christian fired up the turbofans and we headed for the single planned stop,

Keflavik, Iceland. Hours later, we broke through an overcast with Keflavik right off the nose. To minimize time on the ground—the clock was still ticking for a speed record from Montreal to Paris—the company had arranged for a

fuel truck to be waiting for us.

The first to overfly Le Bourget airport was the Learjet 31A, arriving from Belfast. Twelve minutes later, our Learjet passed over the field, with the Learjet 60 (from Wichita via Gander) 94 seconds behind us. The Challenger 604, arriving from Berlin, touched down nine minutes later. The Global Express, which had a two-hour weather delay in New York, landed less than an hour later.

After landing, I collected data from my counterparts on the other aircraft and calculated the elapsed time and average speeds for the various flight legs. Bombardier had made an exciting entrance to the Paris Air Show, and the five crews claimed nine speed records.

—Mike Pablo



NAA observer Mike Pablo (right) sped around the world with pilot Steve Fossett.

ALEX TAI

*Moments & Milestones is produced in association with the National Aeronautic Association. Visit the NAA Web site at [www.naa-usa.org](http://www.naa-usa.org) or call (703) 527-0226.*

## LOG BOOK

### Awards

David Hempleman-Adams, a 44-year-old British explorer and balloonist, will receive the National Aeronautic Association's Harmon Aeronaut (ballooning) Trophy for the year 2000 for his six-day solo flight to the North Pole in an open-basket Roziere balloon. The award will be presented at this year's Kodak Albuquerque International Balloon Fiesta on October 6.

### Events

The National Aeronautic Association will present the Wright Brothers Memorial Trophy at a black-tie gala and dinner hosted by the Aero Club of Washington, D.C., on Friday, December 14, 2001, at the Washington Hilton. The evening will begin with a reception at 6:30 p.m., and dinner will follow at 7:30 p.m. For more information about the awards dinner, contact the Aero Club at (703) 327-7082. The trophy is awarded annually to a living individual who, as a civilian, has performed significant public service of enduring value to U.S. aviation.

### Records

Richard Keyt claimed a world speed record by flying a 500-kilometer closed-circuit course at an average of 307 mph. Keyt flew his experimental aircraft, a Polen Special, from Oshkosh, Wisconsin, to Monticello, Iowa, and back in 70 minutes, 3 seconds during the Experimental Aircraft Association's AirVenture airshow last July 26. (At press time, this record was pending final certification.)

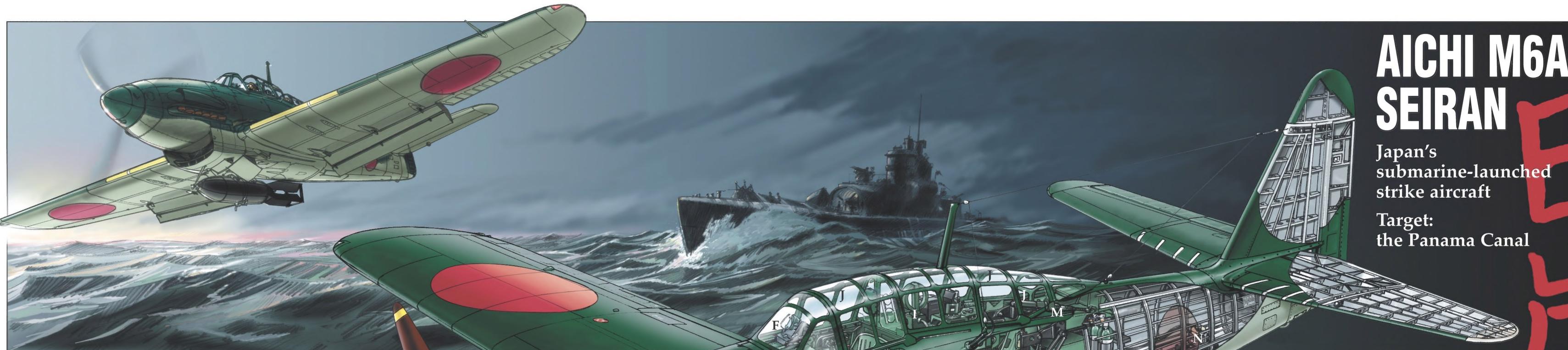
The solar-powered Helios, an unmanned aerial vehicle, climbed to 96,500 feet over Hawaii, claiming a record for true altitude last August 14. A joint venture between California's AeroVironment and NASA, Helios is designed to stay aloft at high altitudes for extended periods, acting as a cheaper substitute for satellites. The aircraft is a flying wing spanning 247 feet, constructed of lightweight composites and powered by 14 two-horsepower electric motors.

# AICHI M6A1 SEIRAN

Japan's submarine-launched strike aircraft

Target:  
the Panama Canal

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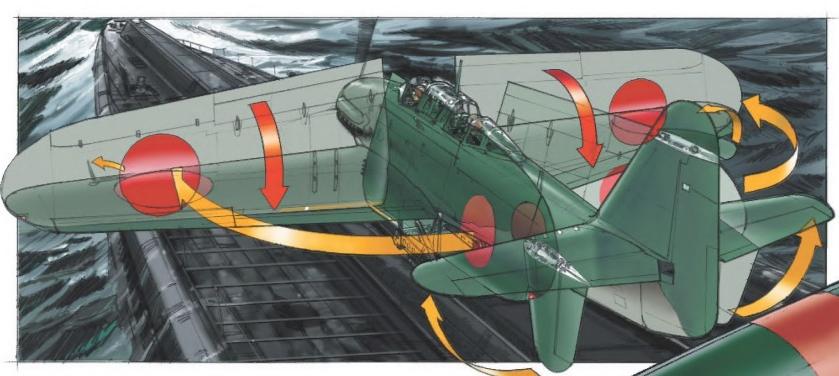


## Aichi M6A1

Originally conceived as a single-mission attack bomber with no landing gear (above), the Seiran was later equipped with floats so that it could be recovered on the water to fly again.

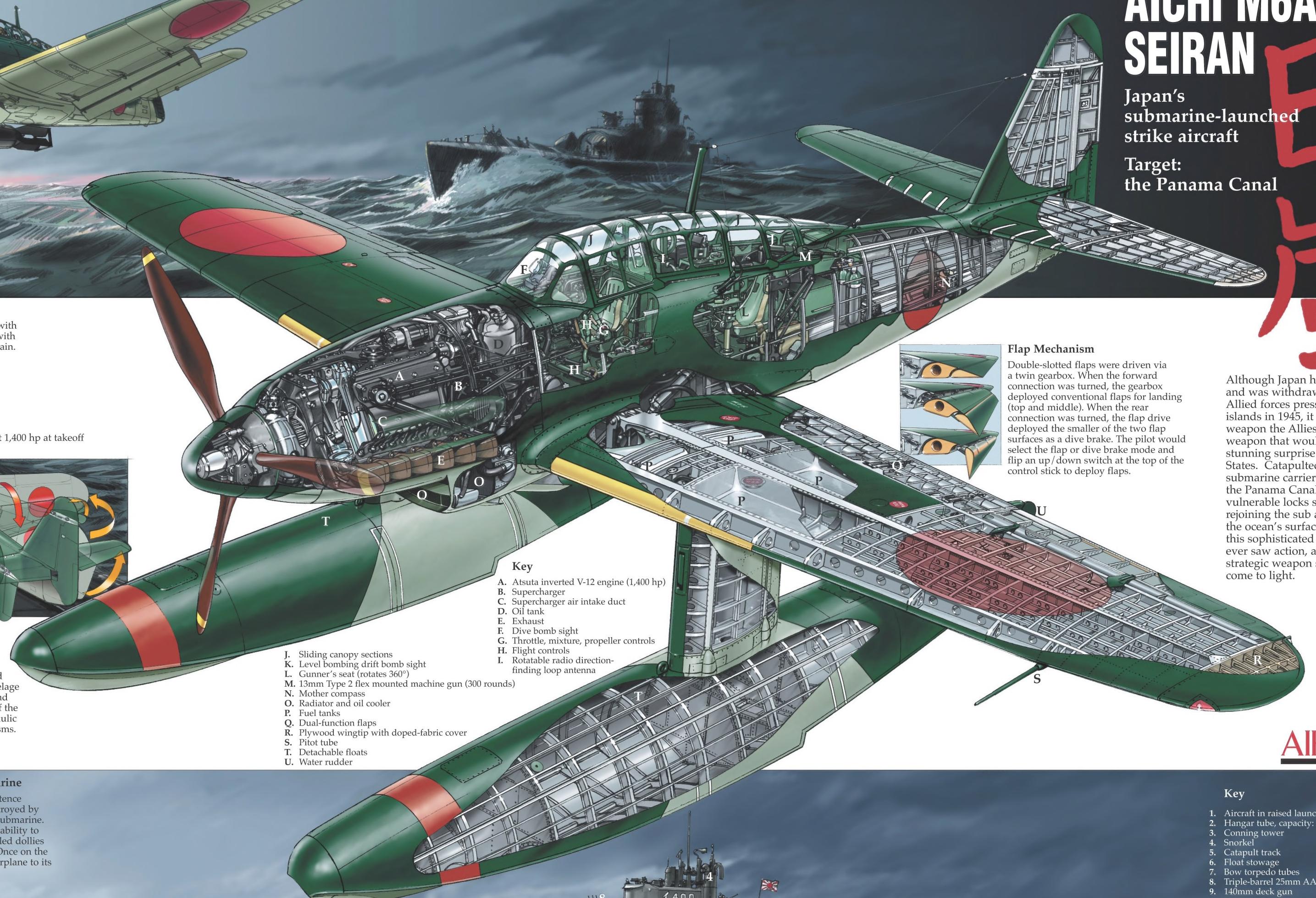
### Specifications\* (with floats):

Length:	38 ft., 2.25 in.
Wing span:	40 ft., 2.25 in.
Height:	15 ft., 0.31 in.
Max. Speed:	295 mph at 17,060 ft.
Range:	739 miles
Engine:	Aichi AE1P Atsuta 32 rated at 1,400 hp at takeoff



### The Folding Airplane

The Seiran had to fold to fit inside an 11.5-foot-diameter hangar. Both wings were flat along the sides of the fuselage, leading edge down. Four crewmen prepared the airplane to launch. The wings, which were connected through the center spar box that passed through the fuselage and rotated with the wings, were first swung forward and then rotated into place. The horizontal tail and the top of the vertical fin were swung up into place and locked. Hydraulic power from the sub powered the wing-folding mechanisms.



### I-400 Class Sen-Toku (Special Attack) Submarine

Japan's I-400 class were the largest submarines in existence at the end of World War II. Of four built, one was destroyed by an air raid and another was converted to a transport submarine. Two Seiran-carrying subs entered service with the capability to launch three aircraft each. The Seirans rested on wheeled dollies that rode on tracks and doubled as launch carriages. Once on the catapult, the dollies extended upward to incline the airplane to its angle of attack for launching.

### Specifications\*:

Length	400 ft., 3 in.
Beam	39 ft., 4 in.
Max. Displacement	5,223 tons
Max. Speed Surfaced	19 knots (22 mph)
Max. Range Surfaced	37,500 miles

\*Source: Monogram Close-Up 13: Aichi M6A1 Seiran, by Robert C. Mikesh

Illustration by Harry Whitver, with special thanks to Kazuto Fukuzawa, Robert McLean, Robert Mikesh, Tom Momiyama, Hiroyuki Nagashima, Matthew Nazzaro, Tetsukuni Watanabe and the Seiran restoration team at the Paul E. Garber Facility.

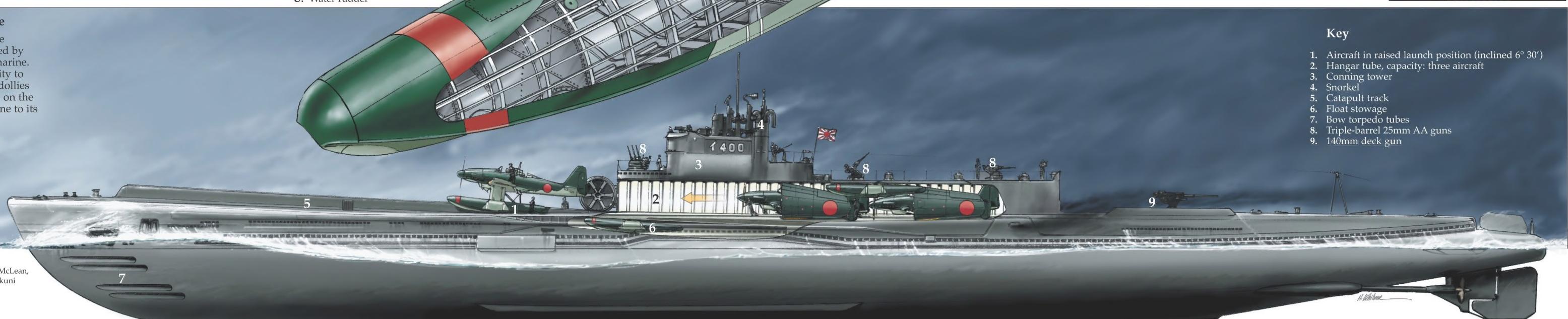
A supplement to the October-November 2001 issue of Air & Space/Smithsonian

© 2001 Smithsonian Institution

Although Japan had lost its forward bases and was withdrawing across the Pacific as Allied forces pressed toward the home islands in 1945, it had one long-range weapon the Allies knew little about, a weapon that would enable it to launch a stunning surprise blow to the United States. Catapulted from enormous submarine carriers, bombers would attack the Panama Canal undetected, strike the vulnerable locks system, and escape by rejoining the sub and vanishing beneath the ocean's surface. The war ended before this sophisticated airplane-submarine duo ever saw action, and their potential as a strategic weapon system has only recently come to light.

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1. Aircraft is raised launch position (inclined 6° 30')
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  5. Catapult track
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  7. Bow torpedo tubes
  8. Triple-barrel 25mm AA guns
  9. 140mm deck gun



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